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TITANIA: BRONZE GROUP BY EPHRAIM KEYSER.

In the late Art Exhibition at Rome, the bronze group "Titania," by Ephraim Keyser, created quite a sensation. It represents the lovely Queen of the Fairies standing on a chariot drawn by squirrels, her toes only resting on the large water-lily leaf which forms the body of the chariot, the wheels consisting of two sunflowers. Her garments are made so fine and transparent that they appear to consist of cobwebs and moonbeams; her hair is ornamented with flowers, and she has two butterfly wings. In her left hand she holds the reins, and in her right a spear of grain, which serves as a whip. A little elf sitting on the rear part of the leaf represents a servant of Titania. This group is now in the possession of the Art Museum of Cincinnati.

The sculptor, Ephraim Keyser, was born in Baltimore, Md., in 1851, and studied in Munich and Berlin from 1872 to 1878. Among other celebrated works of this artist are "The Page" and "The Old Story."—*Illustrirte Zeitung.*

SPAIN is to have the luxury of dining cars on her railways, under the management of a special company, which has obtained a concession of the right of running them for twenty years.

TITANIA: A GROUP IN BRONZE, BY KEYSER.

PETROLATUM IN THE OFFICINAL OINTMENTS.*

By JOSEPH P. REMINGTON.

PETROLATUM, the new officinal ointment base, was probably the subject of more animated discussion in the long series of debates occurring in the last Committee of Revision and Publication of the Pharmacopœia, than any other preparation. The fact that it was a mixture, being composed of hydrocarbons of the paraffin and olefin series, probably ranging from $C_{16}H_{34}$ to $C_{28}H_{60}$ and from $C_{16}H_{32}$ to $C_{27}H_{54}$, and that its physical properties depended to a considerable extent upon the relative proportion of olefin constituents, contributed to the necessity for thorough study and discussion; but the need that was recognized for a non-oxidizable substitute for lard, and the conviction that the cosmolines, vaselines, deodorolines, saxolines, petrolines, etc., in their then condition of varying composition, would not be acceptable in a national authority, was the prime reason for fixing a standard which could be readily reached and would be essentially practical After prolonged consideration, it was finally decided to fix the melting point but slightly above that of the best form of the commercial article, for experience had shown that excellent results had been obtained therapeutically from a petrolatum having a melting point of 40° C. (or 104° F.), and a firmer petrolatum could be readily produced by incorporating yellow wax with it, although care is necessary in the production of this firmer ointment. To insure a homogeneous compound it must be stirred thoroughly and continuously after it has commenced to congeal, while upon the large scale mechanical stirrers are recommended. At the present time petrolatum can be had of excellent quality and fully up to the requirements of the Pharmacopœia, in large quantities cheaper than good lard, and the reduction in price due to competition is still going on, and thus one practical obstacle to its general employment in ointments is overcome. It is not the intention of this paper to enter into a discussion of the therapeutical superiority of petrolatum as a base for ointments; its very extensive use in this connection, by physicians, compelled the Committee of Revision to introduce it into the Pharmacopœia; and if at the time of the decision an adequate supply, made by different manufacturers and not proprietary in its character, could have been assured, it would have probably been directed in the formulas for the ointments. The next revision will, in all probability, require its use in most of the officinal ointments. With the view of obtaining some experience in its general use, the following series of formulas was devised, in which petrolatum is substituted for lard or other animal fat in each one of the officinal cerates and ointments, and one-pound samples are herewith submitted to the association for inspection; the formulas will be accompanied by comments when deemed necessary.

CERATUM.—*Cerate.*—Yellow wax, thirty parts; petrolatum, seventy parts. Melt them together and stir constantly until cool. The cerate made in this way is of a light yellow color, and, of course, would not be recognized as officinal simple cerate; it is nevertheless an excellent dressing, and will retain its properties unimpaired a greater length of time than officinal cerate.

CERATUM CAMPHORÆ.—*Camphor Cerate.*—Camphor liniment, three parts; olive oil, twelve parts; cerate (made with petrolatum), eighty-five parts. Mix the camphor liniment and the olive oil and incorporate with the cerate. This cerate was introduced as the base of cerate of sub-acetate of lead, and when made from petrolatum is more permanent than the officinal. A better and simpler formula in some respects is as follows: powdered camphor, one part; petrolatum, ten parts; cerate (made from petrolatum), one hundred and eighty-nine parts. Warm the petrolatum until it liquefies, then dissolve the camphor in it and incorporate with the cerate.

CERATUM CANTHARIDIS. *Cantharides Cerate.*—Cantharides, in No. 60 powder, thirty-five parts; yellow wax, twenty parts; resin, twenty parts; petrolatum, twenty-five parts. Use the officinal process.

CERATUM CETACEI.—*Spermaceti Cerate.*—Spermaceti, ten parts; yellow wax, twenty-five parts; petrolatum, sixty-five parts. Melt together the spermaceti and wax, then add the petrolatum and stir the mixture constantly until cool. Not white, but much more permanent than the officinal.

CERATUM EXTRACTI CANTHARIDIS.—*Cerate of Extract of Cantharides.*—Cantharides, in No. 60 powder, thirty parts; resin, fifteen parts; yellow wax, thirty-five parts; petrolatum, thirty-five parts; alcohol, a sufficient quantity. Use the officinal process

CERATUM PLUMBI SUBACETATIS.—*Goulard's Cerate.*—Solution of subacetate of lead, twenty parts; camphor cerate (made from petrolatum), eighty parts. Mix them thoroughly. This cerate is more permanent than the officinal, and, in practice, will be found to be very efficient in alleviating acute, active cutaneous inflammation, at times being successful when the officinal ointment does not afford immediate relief. It is yellowish-white in color.

CERATUM RESINÆ.—*Resin Cerate.*—Resin, thirty-five parts; yellow wax, fifteen parts; petrolatum, fifty parts. Melt together at a moderate heat, strain through muslin, and allow it to cool without stirring. The substitution of petrolatum in this cerate is probably not much of an improvement from a therapeutic point of view, as stimulation is the object sought; it would, however, not be objectionable. When made without stirring, a semi-translucent handsome ointment is produced.

CERATUM SABINÆ.—*Savine Cerate.*—Fluid extract of savine, twenty-five parts; resin cerate (made from petrolatum), ninety parts. Use the officinal process.

UNGUENTUM.—*Ointment.*—Petrolatum, eighty parts; yellow wax, twenty parts. Melt the wax and add the petrolatum gradually, then stir the mixture constantly until cool. A yellowish-white ointment, which is firmer in consistence than the petrolatum, having the higher melting point. It is well adapted for use in the firmer class of medicated ointments.

UNGUENTUM ACIDI CARBOLICI.—*Ointment of Carbolic Acid.*—Carbolic acid, ten parts; ointment (made from petrolatum), ninety parts. Mix them thoroughly. This ointment seems to have less tendency to separate than that made by the officinal process; therapeutically there can be but little difference in them.

UNGUENTUM ACIDI GALLICI.—*Ointment of Gallic Acid.*—Gallic acid, ten parts; benzoinated petrolatum, ninety parts. Use the officinal process. Very little benefit was observed when petrolatum was treated with benzoin; the peculiar change in the odor of petrolatum which occurs when it is long kept has been observed in benzoinated petrolatum almost to as great an extent as in simple petrolatum which was exposed for the same length of time. The odor is undoubtedly modified by the presence of the benzoin, but the petrolatum is not changed or protected by it. This ointment is undoubtedly an improvement on the officinal one.

UNGUENTUM ACIDI TANNICI.—*Ointment of Tannic Acid.*—Tannic acid, ten parts; benzoinated petrolatum, ninety parts. Use the officinal process. This is a better ointment therapeutically, than the officinal.

UNGUENTUM AQUÆ ROSÆ.—*Cold Cream.*—Petrolatum, sixty parts; white wax, ten parts; rose water, thirty parts. Use the officinal process. The addition of a small quantity of oil of rose improves this ointment greatly. Although it would be probably useless to attempt to dispense this improved ointment, in ordinary counter practice, as cold cream, because of its yellowish color, there is no question of the superiority of the petrolatum cold cream as a practical dressing and emollient.

UNGUENTUM BELLADONNÆ.—*Belladonna Ointment.*—Alcoholic extract of belladonna, ten parts; diluted alcohol, six parts; petrolatum, eighty-four parts. Rub the extract with the diluted alcohol until uniformly soft, gradually add the petrolatum, and mix thoroughly. An improvement over the officinal ointment therapeutically.

UNGUENTUM CHRYSAROBINI.—*Chrysarobin Ointment.*—Chrysarobin, ten parts; petrolatum, ninety parts. Rub the chrysarobin with the petrolatum, gradually added, until they are thoroughly mixed. A better ointment may be made, however, by digesting the mixture in a water-bath and stirring thoroughly as it cools.

UNGUENTUM DIACHYLON.—*Diachylon Ointment.*—Lead plaster, sixty parts; petrolatum, thirty-nine parts; oil of lavender, one part; melt together the lead plaster and petrolatum at a moderate heat; then, having permitted the mass to become partly cool, incorporate with it the oil of lavender, and stir constantly until cold. This ointment is a decided improvement on the officinal formula, it keeps much better, does not separate, and is not so adhesive On account of the want of uniformity in the quality of olive oil permitted by the Pharmacopœia, physicians often complain of the irritant effects produced by the use of this ointment as ordinarily dispensed. The use of petrolatum would undoubtedly do away with these difficulties, and a smooth, non-irritating, and more permanent ointment than the officinal be produced.

UNGUENTUM GALLÆ.—*Nutgall Ointment.*—Nutgall in No. 80 powder, ten parts; petrolatum, ninety parts. Rub the nutgall, with the petrolatum, gradually added, until they are thoroughly mixed For therapeutical reasons this is preferable to the officinal.

UNGUENTUM HYDRARGYRI.—*Mercurial Ointment.*—Mercury, four hundred and fifty parts; petrolatum, three hundred parts; yellow wax, one hundred and fifty parts; compound tincture of benzoin, forty parts; mercurial ointment, one hundred parts. Mix the mercury with the tincture of benzoin in a mortar, add the mercurial ointment (which should contain fifty per cent. of mercury), and triturate the mixture until globules of mercury cease to be visible; then add the petrolatum and yellow wax, previously melted together and partially cooled, and continue the trituration until globules of mercury cease to be visible under a magnifying power of ten diameters. This is believed to be a better ointment than the officinal, for both lard and suet are dispensed with, the necessary firmness being imparted by yellow wax; the process is partically more rapid than the officinal, because suet is almost granular in its character, and prolonged trituration is necessary to break down the granules; the disagreeable odor always present in suet, is of course absent in the improved preparation, while rancidity is effectually prevented.

UNGUENTUM HYDRARGYRI AMMONIATI. — *Ointment of Ammoniated Mercury.* Ammoniated mercury, in very fine powder, ten parts; petrolatum, ninety parts. Rub the ammoniated mercury with the petrolatum, gradually added, until they are thoroughly mixed. Preferred for therapeutical reasons.

UNGUENTUM HYDRARGYRI NITRATIS.—*Citrine Ointment.*—The practice which has been indulged in to some extent of making citrine ointment from petrolatum is one which should be condemned. The well-recognized therapeutic effects caused by the use of this ointment are probably due not only to the presence of the acid nitrate of mercury, but to the elaidin produced by the action of nitric acid upon olein. Now it has been shown by Schorlemmer that hot nitric acid attacks octane, one of the higher members of the paraffin group, and that succinic acid is one of the products, but it is yet to be proved that the resulting compounds, if any, produced by reacting upon petrolatum with nitric acid, under the circumsances detailed by the officinal process, are valuable. Indeed, it is very probable that the chemical changes are slight, and it is very fair to assume that totally different products must result when a mixture of paraffins is treated with nitric acid than when the olein in an animal oil is so treated.

Practical results seem to verify this view, for the attempts to produce ointment of nitrate of mercury from petrolatum, which have been made by various investigators from time to time, have proved failures; a spongy yellowish mass, filled with bubbles of gases resulting from decomposition, and ultimately turning brown, is the result. The present officinal process, if strictly adhered to, gives an excellent product, and, for the reasons above given, the writer recommends it in preference to all others.

UNGUENTUM HYDRARGYRI OXIDI FLAVI.—*Ointment of Yellow Oxide of Mercury.*—Yellow oxide of mercury, in very fine powder, ten parts; ointment (made from petrolatum; see unguentum), ninety parts. Rub the oxide of mercury with the ointment gradually added until they are thoroughly mixed. Preferred to the officinal from therapeutical reasons.

UNGUENTUM HYDRARGYRI OXIDI RUBRI.—*Ointment of Red Oxide of Mercury.*—Red oxide of mercury, in very fine powder, ten parts; ointment (made from petrolatum; see unguentum), ninety parts. Rub the oxide of mercury with a small quantity of the ointment until a perfectly smooth mixture is obtained; then gradually add the remainder of the ointment, and mix thoroughly. More permanent than the officinal, and preferable therapeutically.

UNGUENTUM IODI.—*Iodine Ointment.*—Iodine, four parts; iodide of potassium, one part; water, two parts; petrolatum, ninety-three parts; use the officinal process. A dark greenish black ointment is produced, which is probably not inferior to the officinal. The advantages of the use of petrolatum here are not so apparent as in some of the other ointments.

UNGUENTUM IODOFORMI.—*Iodoform Ointment.*—Iodoform in very fine powder, ten parts; petrolatum, ninety parts. Rub the iodoform with the petrolatum, gradually added until they are thoroughly mixed. Preferable on therapeutic grounds.

UNGUENTUM MEZEREI.—*Mezereum Ointment.*—Fluid extract of mezereum, twenty-five parts; petrolatum, eighty parts; yellow wax, twelve parts. Melt together the petrolatum and wax with a moderate heat, add the fluid extract, and stir the mixture constantly until the alcohol has evaporated, then continue to stir until cool. The advantages of petrolatum in this ointment over lard are not very apparent, as it is used as a stimulating application.

UNGUENTUM PICIS LIQUIDÆ.—*Tar Ointment.*—The use of petrolatum here is not recommended, although, if desirable, a mixture of yellow wax and petrolatum of the consistence of suet could be used.

UNGUENTUM PLUMBI CARBONATIS.—*Ointment of Carbonate of Lead.*—Carbonate of lead, in very fine powder, ten parts; petrolatum, ninety parts. Rub the carbonate of lead with the petrolatum, gradually added until they are thoroughly mixed. Preferable therapeutically to the officinal.

UNGUENTUM PLUMBI IODIDI.—*Ointment of Iodide of Lead.*—Iodide of lead, in very fine powder, ten parts; petrolatum, ninety parts. Rub the iodide of lead with petrolatum gradually added until they are thoroughly mixed. A bright orange-colored ointment, which darkens on the surface when exposed.

UNGUENTUM POTASSII IODIDI.—*Ointment of Iodide of Potassium.*—Iodide of potassium, in fine powder, twelve parts; hyposulphite of sodium, one part; boiling water, six parts; petrolatum, eighty-one parts. Dissolve the iodide of potassium and the hyposulphite of sodium in the boiling water in a warm mortar; then gradually add the petrolatum and mix thoroughly. This ointment is of a lemon-yellow color, but shows a disposition to separate on keeping, due to the presence of the water; it should only be made as it is needed.

UNGUENTUM STRAMONII. — *Stramonium Ointment.*—Extract of stramonium, ten parts; water, five parts; petrolatum, eighty-five parts. Rub the extract with the water until uniformly soft, then gradually add the petrolatum and mix thoroughly. Very much preferable to the officinal, in the treatment of hemorrhoids

UNGUENTUM SULPHURIS.—*Sulphur Ointment.*—Sublimed sulphur, thirty parts; petrolatum, seventy parts. Rub the sulphur with the petrolatum, gradually added until they are thoroughly mixed. Probably no better than the officinal.

UNGUENTUM SULPHURIS ALKALINUM —*Alkaline Sulphur Ointment* —Washed sulphur, twenty parts; carbonate of potassium, ten parts; water, five parts; petrolatum, sixty-five parts. Rub the sulphur with the carbonate of potassium and the water, gradually add the petrolatum, and mix thoroughly. Preferable, on therapeutic grounds, to the officinal.

UNGUENTUM VERATRINÆ.— *Veratrine Ointment.*—Veratrine, four parts; alcohol, six parts; petrolatum, ninety-six parts. Rub the veratrine with the alcohol in a warm mortar until dissolved, then gradually add the petrolatum and mix thoroughly. This ointment is much darker in color than the ointment formerly officinal, due to the complete solution of the veratrine. When made from petrolatum it is probably more efficient than when made from lard, because of its more rapid absorption.

UNGUENTUM ZINCI OXIDI.—*Ointment of Oxide of Zinc.*—Oxide of zinc, twenty parts; petrolatum, eighty parts. Rub the oxide of zinc with twenty parts of petrolatum previously melted, until the mixture is perfectly smooth; then add the remainder of the petrolatum and mix thoroughly. This ointment does not equal the officinal in appearance; it is not white nor does it have the pleasant balsamic odor due to the benzoin, but when used to allay irritation, as in acute eczema, the ointment made from petrolatum will frequently be preferred.

* Read at the Sixth Session of the Thirty-first Annual Meeting of the American Pharmaceutical Association.

EXERCISE vs. BANTINGISM.

OBESITY is a disease—a gradual, yet a true perversion of a normal state, and therefore a disease—which from its continual irksomeness, apart from any worse symptoms, renders those who suffer from it particularly ready to accept any means of relief, reasonable or unreasonable, if only it will ease them of their burden. It would be superfluous to review the various systems professedly based on scientific principles, but really founded too often on fallacious reasoning, which have claimed to achieve this result.

When one considers the slow development of this condition, its selection of certain individuals in preference to others who consume the same ingredients of diet, and the other circumstances of those affected, it is clear that there is some inherent state of being or habit of life which, more than mere quality of food, conduces to excessive fat formation. For its safe and effectual treatment, provided that the case be not of so long standing as to be beyond all treatment, this state must first be understood and regulated.

It is well known that whatever interferes with oxidation, with due metamorphosis of digested food within the tissues, is apt to lead to its storage in the form of fat. This is true not only of fat itself, but also, though in a much less degree, of substances—as albumen—far removed from it in the scale of chemical change. Such interference arises, on the one hand, from the ingestion of more food than can possibly undergo assimilation, especially if it be largely composed of carbohydrates; on the other, from insufficient demand for formative material on the part of the tissue elements themselves, and this demand is proportionate to their loss by exertion.

It is therefore necessary for health that consumption should be limited as nearly as may be to what is necessary for sustenance, and that discharge of waste and tissue demand should be at the same time encouraged by moderate bodily exercise. But, moreover, the limitation of food must be in its quantity rather than its kind. A certain mixed diet is requisite for healthy growth, and neither fatty, farinaceous, nor albuminoid material can be omitted from it in any considerable proportion without detriment to the general nutrition. If the stout man who desires to be thin will restrict himself to a lean meat diet, taking but a trifling amount of the other more carbonaceous substances, after the Banting method, he will indeed lose bulk, but the restriction will not arrest his fat-forming propensity, which still survives, though on reduced fare, and will return to him as soon as he resumes his former mode of living.

Moreover, his Bantingism must either underfeed the non-fatty tissues in respect of their most important constituent, carbon, or to avoid this must so overload every organ, but especially the kidneys, with surplus albuminoid excreta as to cause their overwork and degeneration at no distant date. The danger, though still real, is less to men of active habits, but such the obese commonly are not. By this method we seek to avoid one trouble, with partial success, only to fall into another, perhaps worse. While, therefore, we are ready to admit that stout persons should be content with a less rich diet than the spare-bodied, we are careful to preserve its essentially mixed character, to limit its consumption

in quantity, and to rely for disposal of the products of digestion mainly on regular and methodical physical exertion.

There should be no difficulty about this latter, seeing that it may be taken in different forms suited to various ages and constitutional types. Walking, riding, rowing, and for the younger and more robust, athletic exercises of more energetic kinds, are among the most valuable, from their exercising more or less the whole of the muscular energies. Then there are many kinds of amateur work which offer the same advantages. By all such means free play is afforded for tissue changes, for excretion of waste, and for regular and rapid blood circulation. In short, it is necessary for him who would enjoy the ease of an unencumbered person to remember in practice that the laws of supply and demand have a relation to one another as close and as inseparable in the human frame as in the commercial world.—*Lancet.*

DIETETICS FOR THE SICK.

AT a recent meeting of the Philadelphia County Medical Society, Dr. Charles M. Seltzer read the following paper:

In presenting this paper, it is but justice to state that it has been prepared during the leisure of the past week as a substitute for one by another member, who was unable to keep his engagement. The subject has been selected more from the hope of eliciting some practical ideas, and a desire to emphasize its importance, than to announce anything new, or to exhibit the best paces of a hobby. Close attention to the methods of our most successful general practitioners convinced me that in dietetics was their stronghold. At the same time there was plainly to be seen a distressing lack of knowledge as to variety of foods and the preparation of them. In order to find out whether there was a practical remedy for these two great faults, I have gone over a thorough course of preparation of diet for the sick, under the instructions and guidance of Mrs. S. T. Rorer, in whom are combined the practical attributes of cook, chemist, physiologist, and nurse, and I can safely say that, if every member of this society were to do likewise, his *armamentarium*, success, and self satisfaction in the practice of medicine would be increased manyfold.

It would be almost an endless task to discuss the literature of this subject. Let us condense the opinions of physiologists, chemists, hygienists, and all others in authority, by stating that food is divided into nitrogenous or albuminous; hydrocarbons, or starch, sugar, and fats; and mineral, or the various salts of the alkalies. Of these, the nitrogenous and minerals are the building materials, and the hydrocarbons are the heat and force-producers. Food may also be classified into liquid, semi-solid, and solid; and, as the sum total of digestion is a matter of absorption and assimilation, it follows that the more liquid or dissolvable food is, the more readily will it be absorbed; hence this is the form to be chosen when it is desirable to obtain nourishment at the least possible expense of organic action. There are also conditions in which bulk and solidity are necessary, and here we select the semi-solid or solid food, or even indigestible matter.

Nitrogenous food, in its natural combination with mineral matters, is mostly made absorbable by stomachic digestion; it rebuilds the tissues, and the waste and refuse are excreted by the kidneys and skin as urea and uric acid and its salts.

Hydrocarbons are digested in the mouth and small intestines, are burnt up by union with the respired oxygen, thus supplying heat and force to the body. The waste and refuse are excreted by the lungs and bowels.

About three ounces of nitrogenous and twenty ounces of carbonaceous food are necessary to sustain the life of an adult man in idleness. With these epitomized facts in mind, let us consider the importance and use of dietetics in the treatment of disease. The importance has been signalized by Bence Jones, who has said that the effect of diet is far beyond any known remedy. This fact has been so well known for the past century that volume after volume has been written on "Dietetics," "Diet Cures," etc. A few of these have become standard works of authority, because of their scientific and exhaustive treatment of the subject, while hundreds of others have had but an ephemeral existence. All have had to reiterate the same facts, because very few new ones have been learned, and, aside from the knowledge of artificially digested food, the student of a hundred years ago knew as well as the student of to-day about what diet was necessary for the sick. True, theirs was an empirical teaching; they knew nothing of the physiological actions of diastase, pepsin, and pancreatin, but they were all the more practical for that. Our present scientific reasonings on digestion are but the formation of rules and theories for very old facts. The importance of the subject is made more manifest when we consider how much of the sickness that we are called upon to treat is the result of some error in eating or drinking, and, as "removal of the cause" is the first step toward the promotion of recovery, it is easy to perceive how essential it is to know what constitutes proper and improper diet. Life depends upon diet, and the restoration of health depends upon the same principles as its preservation. Disease is the result of the violation of the laws of health, hence the first step toward recovery is to re-establish those laws; and as the material for repair and support must come from diet, we, as thorough physicians, should have a complete *practical* knowledge of dietetics and a proper appreciation of their curative value. But almost a decade of experience among physicians compels me to acknowledge that this is not the case, and that the most lamentable deficiency is in the practical application of the subject. Nature's simple and easily understood remedies are either lost sight of or ignored in the blind endeavor to find a medical specific for every human ill, or to establish an ideal notion, theory, or pathy. For the treatment of chronic affections, some good points may occasionally be gained by even observing the *modus operandi* of quacks, homœoquacks, and proprietary medicines, for in connection with either a depurative or inoperative preparation such dietetic and hygienic directions are almost invariably *insisted* upon as would, in themselves, relieve temporarily, and perhaps permanently, some of the most obstinate cases.

The methods of dietetic treatment of diseases are as various as are the ills that flesh is heir to, but all of them contain some of the following principles as essential features. In acute diseases, *rest* is of primary importance; it is the fundamental principle of their medical and surgical treatment, and the same idea must be carried out in dietetics by remembering what part each organ serves in absorption, assimilation, and excretion, and by avoiding such food as would cause the performance of that function. Of course, this plan is only to be pursued while the disease is advancing, and as soon as recovery begins there must be a gradual return to a promiscuous diet; very little at first—just enough to slightly exercise the crippled organ, using as great care as we would in instituting passive motion in a limb that has been fractured. Nature enforces this principle by the loss of appetite that marks the onset of nearly all acute diseases. The dietetic rest of an organ does not necessarily imply a depletory diet, for, while it is non-active, other organs may be made to perform a compensatory amount of work, and thus sustain or even increase the patient's vitality—so great is the versatility of our organic functions. It is upon this idea that we must act when we obey the command of Graves to feed fevers. In chronic diseases—those in which the natural course is direct from bad to worse, until death or some interposing process puts an end to them—every organ must be made to do its utmost; the whole system must be awakened to the threatening destruction. Herein lies the broadest field of action for our subject. No time should be lost; food should be administered as frequently as assimilation and proper amount of organic rest will allow; the appetite should be kept active, by using liquid, semi-solid, and solid food, prepared in such a variety of ways as to allow no charge of monotony or disgust. Surprise is frequently a useful element. Instead of leaving the patient to vacillate over his or her likes and dislikes, the nurse should be privately instructed how and what to prepare for each time, and how to serve it in the most appetizing manner. A valuable aid, usually lost sight of, is condiment. Think but for a moment how a savory dish will sharpen our appetites while in health, and I am sure you will perceive its stimulating influence upon a debilitated patient, to whom the flat and insipid preparations usually offered are loathsome, or even nauseating. This disgust might frequently be avoided, and the amount of prescribed medicine be lessened. Many of the bitter tonics and carminatives of our materia medica are the same as are used in cookery, and are none the less efficacious in a palatable dish than in the nauseous pill or draught. Therefore let the delicate aroma of herbs, celery, and bay-leaves pervade the soups; use India curry on starchy foods; and, when desirable, add *capsicum, piper nigrum*, etc., to animal broths and substances. In so doing, if necessary, you can satisfy the qualms of your professional dignity by remembering that in catering to the palate you reflexly stimulate the organs of digestion.

Some articles of diet may be administered simply for their curative effect. A five-ounce cup of strong coffee contains about sixty-six grains of extract, or an equivalent of about two grains of *caffeine*—quite sufficient to relieve a neuralgia, or a headache and sick stomach after a dose of opium. Beef-tea, made red-hot with red pepper, is the very best treatment for delirium tremens. A patient to whom I once administered such a dose, made so strong that I would not have dared to taste it myself, afterward told me that it was the most refreshing and *cooling* drink he had ever taken. A London surgeon to the police told me that he had treated a hundred and fifty cases of delirium tremens with this remedy *alone*, and had not lost one. The use of *chloral* in these cases is criminal, and many a death certificate of "delirium tremens" ought to be "heart failure from chloral poisoning." Mucilaginous teas and drinks made from gelatin, isinglass, Irish moss, and flaxseed are very soothing to any inflammation within the digestive tract. Green vegetables are necessary to cure as well as prevent scurvy.

An old practitioner, who had spent his early professional life in the country, told me that when he first commenced practicing he used all the ordinary remedies in typhoid fever without any satisfactory results, until the introduction of turpentine by the late Professor George B. Wood. In it he soon discovered a useful ally, not so much in the drug *per se*, but because convenience and time compelled him to use a thick flour gruel as a vehicle, and the patients were nourished sufficiently to live through the attack.

In the science and art of preparing sick diet there is a most lamentable lack of knowledge, especially among physicians. They know the preparations by name, but not by nature, and the only way to learn the latter is to don the apron and take a practical course from a practical and scientific cook. Such a course was inaugurated last winter in this city and in Boston, with a very satisfactory result. The prospect for this season in this city is that the course will be very well attended. It is the only way to learn. I could read you receipts by the score, but it would be as useless as reading off so many medical formulæ.

THE DIAGNOSIS AND HYGIENE OF TYPHOID FEVER.

By E. HOCHHEIMER, M.D., Assistant Sanitary Inspector, New York Health Department.

HAVING been assigned by the Board of Health to the investigation of the sanitary conditions attending or causing typhoid fever, several circumstances regarding its etiology and diagnosis have forced themselves upon my notice, to which, as they differ somewhat from generally received opinion, it appears advisable to call the attention of the profession especially at the present time, when the disease is encountered with such unusual frequency.

Judging from the clinical picture of typhoid fever as usually given in the text-books, its diagnosis would seem an easy matter. The malaise which precedes its advent, the chill which marks its onset, the headache, epistaxis, diarrhœa, abdominal tenderness, ileo-cæcal gurgling, roseola, tympanites, enlargement of the spleen, cough, appearance of the tongue, and, above all, the peculiar, regular remissions and exacerbations of the fever, make up a group of symptoms which stamp the features of a disease easily recognizable and not to be mistaken. Whatever may be the cause, whether the above description is a mere generalization, or whether there is something about the climate and hygienic condition of this city which materially modifies the appearance of the symptoms, I shall not stop to speculate. The fact, however, remains, that in the great majority of cases as at present met with, the task of arriving at a positive opinion is by no means an easy one. As a rule this is not accomplished until the second or even the third week; and it is not magnifying the difficulty of making a diagnosis to assert that, in most instances, there is none of the exanthematous or zymotic diseases which it is so hard to recognize early. And yet this early recognition of the disease is of the highest importance, for many reasons: it will aid the attending physician to discover the conditions producing or assisting to cause the disease, lead to the use of proper precautions to prevent its spread, direct the correct line of treatment, and enable him, in uncomplicated cases, to foretell its natural course and duration, and thus keep the friends and relatives from expecting impossibilities, and dooming themselves to inevitable disappointment.

The disease ordinarily begins in a manner resembling an attack of malarial fever. The patient complains of weariness and inaptitude for exertion, and there is generally more or less elevation of temperature. There may be a chill, but this is the exception and not the rule; the same is true of the epistaxis. The condition of the intestinal action is variable; in many, diarrhœa is present, while in probably an equal number the movements are natural or the patient is even constipated. The appearance of the tongue is equally uncertain; sometimes it is coated, sometimes dry, sometimes almost normal. The coating, when present, may be white, yellow, or brown, and situated at the base, at the sides, at the tip, or in the center; in short, it shows nothing more than is to be seen in any fever or inflammation. Abdominal tenderness is a more constant symptom, but not by any means met with in every case; in some instances it is probably present, but the patient's mental hebetude prevents its being appreciated. The cerebral symptoms are very irregular; while many subjects complain of headache, or a sense of fullness across the forehead, others do not deviate in this respect from their usual condition. The "characteristic temperature curve" of the first week will seldom be observed.

The above hasty glance at the more common manifestations of the disease in question would apparently leave us in a very uncertain state of mind, in the first few days of the sickness, as to the nature of the patient's complaint. This is undoubtedly true, except where there has been another case of typhoid fever in the house shortly before, the diagnosis must be mainly made by exclusion. But the darkness is not so profound as it may, at first sight, appear. In the first place, there is the fever, more or less continuous; secondly, in addition, there are generally one or more of the other symptoms, and in this disease, to borrow a phrase from homœopathy, it is especially necessary to have in view "the totality of the symptoms;" thirdly, any case of "malarial fever" which persists longer than three days in spite of sufficient administration of quinine should excite suspicion of typhoid; and lastly, there is a symptom which is peculiar and so constant that it may almost be regarded as pathognomonic, *the roseola.*

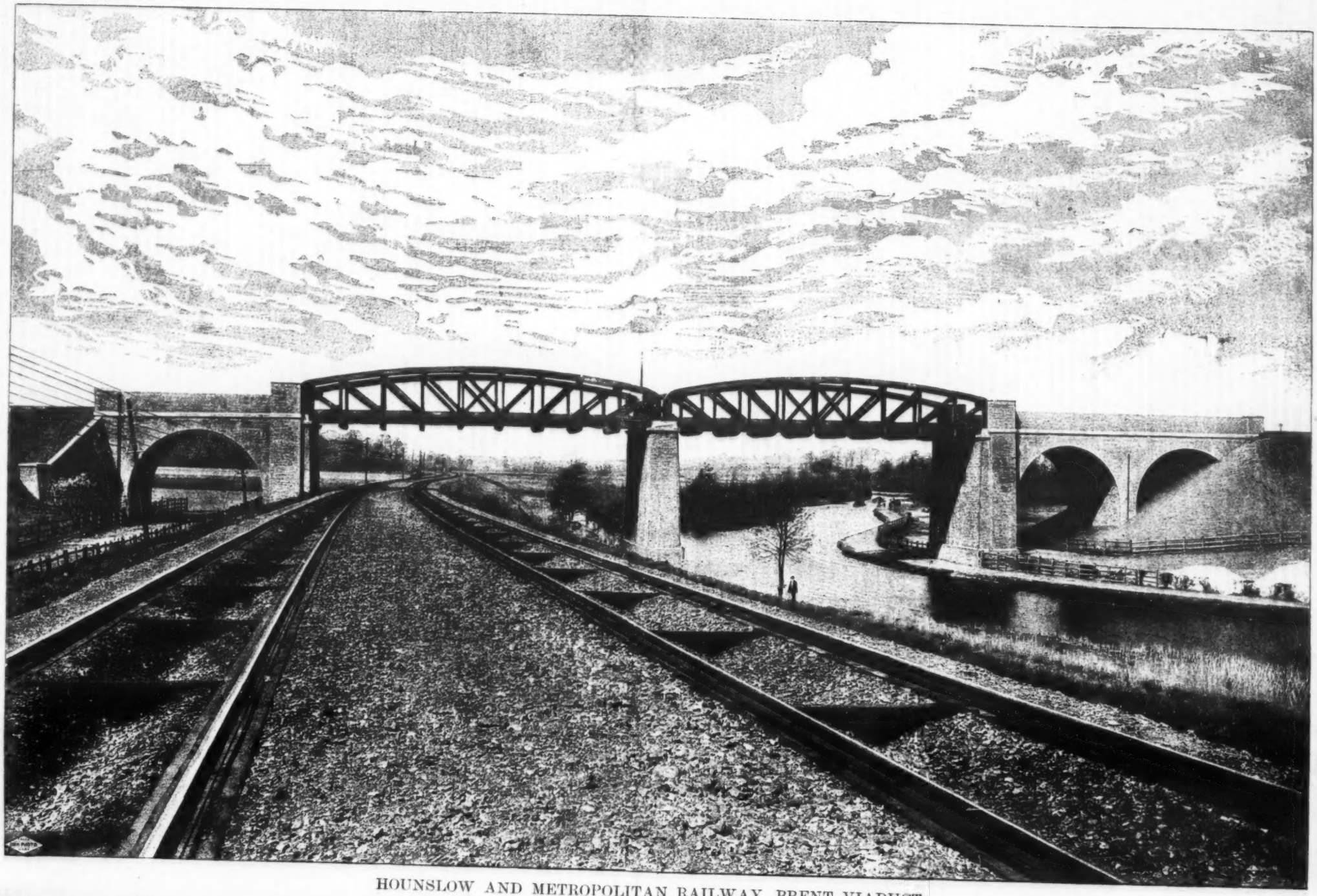
The time at which these spots appear varies; they may be met with as early as the third day or not until the end of the first week. Nor are they always, strictly speaking, on the abdomen: they occur sometimes on the pubes, or, perhaps, most commonly, over the lower ribs. Neither are they always confined to the trunk; in exceptional cases they invade the extremities as well, and this without any apparent relation to the severity of the attack. In size they are from the one-thirty-second to the one-sixteenth of an inch in diameter, depending upon the character of the skin, being smaller in young subjects and in those who have delicate skins. The same remark applies to their elevation above the surrounding integument: they may be not at all raised, or elevated almost to papules. They are smooth, and, when they are most palpable, in running the finger over them but a slight resistance is encountered. In color they are bright red, and they *disappear completely on pressure*, showing again quite promptly when the pressure is removed, the rapidity of their reappearance depending, of course, on the activity of the circulation. In number they vary within wide limits; there may be only one spot in the course of the disease, or, as stated above, there may be an eruption covering the greater part of the body and coming out in successive crops. But whether they be few or many, their presence is almost constant, and, if carefully looked for, particularly during the second week, they will be found in probably no less than ninety to ninety-five per cent. of all cases. In short, they are so peculiar and characteristic that they cannot fail to be of the highest diagnostic value.

The bronchitis, which generally shows itself at the end of the first week, is likewise one of the most constant symptoms; and while, of course, it may be accidental, taken in connection with the other symptoms it may assist in arriving at a conclusion in doubtful cases.

As to the sanitary conditions under which typhoid fever occurs, a few words must suffice. While it cannot be denied that in many, perhaps the majority of cases, no particular defect can be discovered, still in a very large number obvious cause can be found. Prominent among these may be mentioned untrapped or unventilated waste-pipes, leaky discharge tubes, sewers, or soil pipes, lack of water in the water-closets, or school-sinks, and foul-smelling, badly cared-for privy-vaults. Where more than one case has occurred in a house, one or more of the above conditions will be rarely absent.

It would appear almost an impertinence on my part to say anything with reference to the precautions necessary to prevent the spread of the disease, and yet so frequently do both my colleagues and myself see them neglected, that it may not be out of place to call particular attention to them. It is apparently well established that the *materies morbi* lies in the discharges from the bowels, and only becomes active after they have undergone a certain amount of decomposition or fermentation. The process of prevention is therefore simple and direct; all that is required is to thoroughly and speedily disinfect the stools or anything that has been soiled by them. Copperas is very good for this purpose, and has the advantage of being cheap and odorless. A solution of this should always be kept in the chamber or bed-pan, and when the patient has a movement of the bowels the vessel should be emptied at once and well rinsed, and have some of the disinfectant again put into it. If the patient's linen or bed-clothes should accidentally be soiled, they should be changed at once and disinfected: for this purpose hot water is excellent, and the solution of chlorinated soda, known in the laundry under the name of Javelle water, is to be commended. The patient's undergarments, etc., should not be washed with the clothing of other members of the household. It is hardly necessary to add that to sprinkle carbolic acid or to strew chloride of lime about the sick chamber is, to say the least, of doubtful utility. The practice of keeping the discharges for the doctor's inspection is a source of danger, and, except in rare instances, it should not be countenanced. These measures cannot be begun too early; the attending physician should not be content with giving general directions, but should lay down strict and minute instructions for disinfection, and by daily inquiry see to it that they are complied with.—*Medical Record.*

THE wooden pavement hitherto in use in London is to be removed for sanitary reasons. Prof. Tyndale says that the constant wetting and decay of the wood causes an emanation of pernicious dust. The trouble comes from the saturation of the dust with water. That is unhealthy anywhere, and with any kind of pavement.

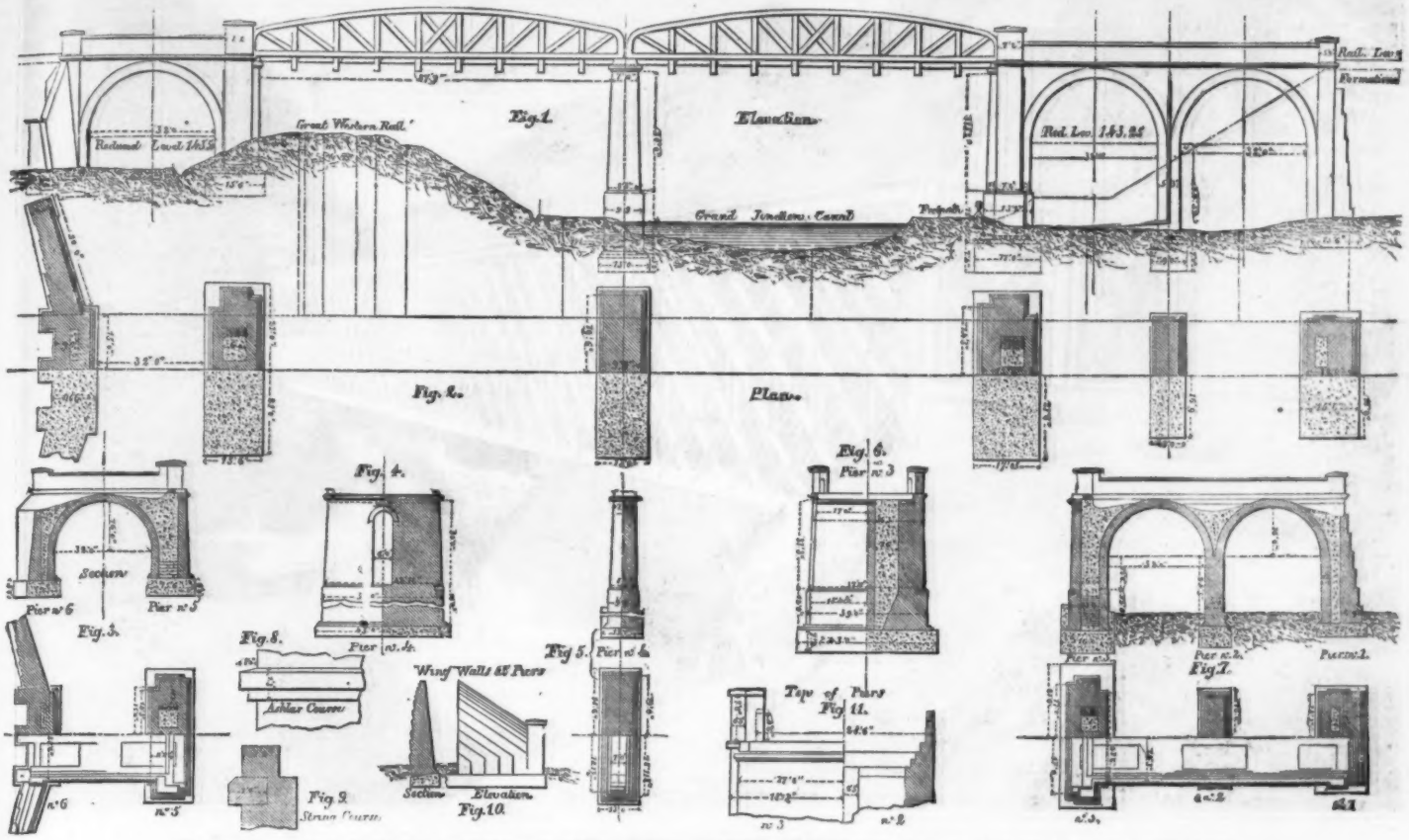


HOUNSLOW AND METROPOLITAN RAILWAY, BRENT VIADUCT.

MESSRS. WELLS-OWEN & ELWES, WESTMINSTER, ENGINEERS.

BRENT VIADUCT.

THE Hounslow and Metropolitan Railway, London, was opened last May. It commences by a junction with the Ealing extension of the District Railway at Mill Hill Park station, passes near Gunnersbury park, through South Ealing, north of Brentford, crossing the Grand Junction Canal, and the Great Western Brentford branch by a brick and iron viaduct, thence near Osterley park and through the northern part of Spring grove to the High street of Hounslow, where for the present it terminates. There are stations at South Ealing, Broton road—for North Brentford and Hanwell—Spring grove and High street, Hounslow. The line will be worked by the District Company, who will run through trains from the Mansion House to Hounslow. The engineers are Messrs. Wells-Owen and Elwes, MM. Inst. C.E.; and the contractors, Messrs. Eckersley and Baylis. Our engravings illustrate the Brent Viaduct, which, as will be seen, is a fine example of engineering.



BRENT VIADUCT, HOUNSLOW AND METROPOLITAN RAILWAY, LONDON.

RACK AND PINION LOCOMOTIVE FOR NARROW GAUGES.

THE locomotive represented in the accompanying engravings is built upon an entirely new principle, and has been running upon a railroad which traverses the valley of Kunster, near Struthuten, in Rhenish Prussia.

Its boiler, which does not perceptibly differ from those usually employed for engines of this kind, rests upon an iron frame formed of two longitudinal beams, A, which are cross-braced with iron-plate. In the interior of the frame there are two longitudinal beams, B, upon which are fixed four bearings, *m*, *n*, *o*, and *p*, which receive the journals of four axles, M, N, O, and P. The total weight of the engine is carried by the bearings, *n* and *o*, which are surmounted by suspension rods connected with the springs, C and D.

The driving axle, N, and the fore axle, G, carry wheels that are spaced sufficiently wide apart for a 2·78 foot track, while the auxiliary wheels, M and P, are capable of running upon rails spaced 2·3 feet apart. Upon the driving axle, N, there is keyed a pinion, R, which engages with a rack, S, mounted along the axis of the roadway wherever there are gradients. This rack is held by bolts between two ⊔ irons which are fixed upon wooden stringers. When the engine is running on a level over its ordinary 2·78 foot track, it operates like any other locomotive, that is to say, its driving and fore wheels are alone in contact with the rails, while its

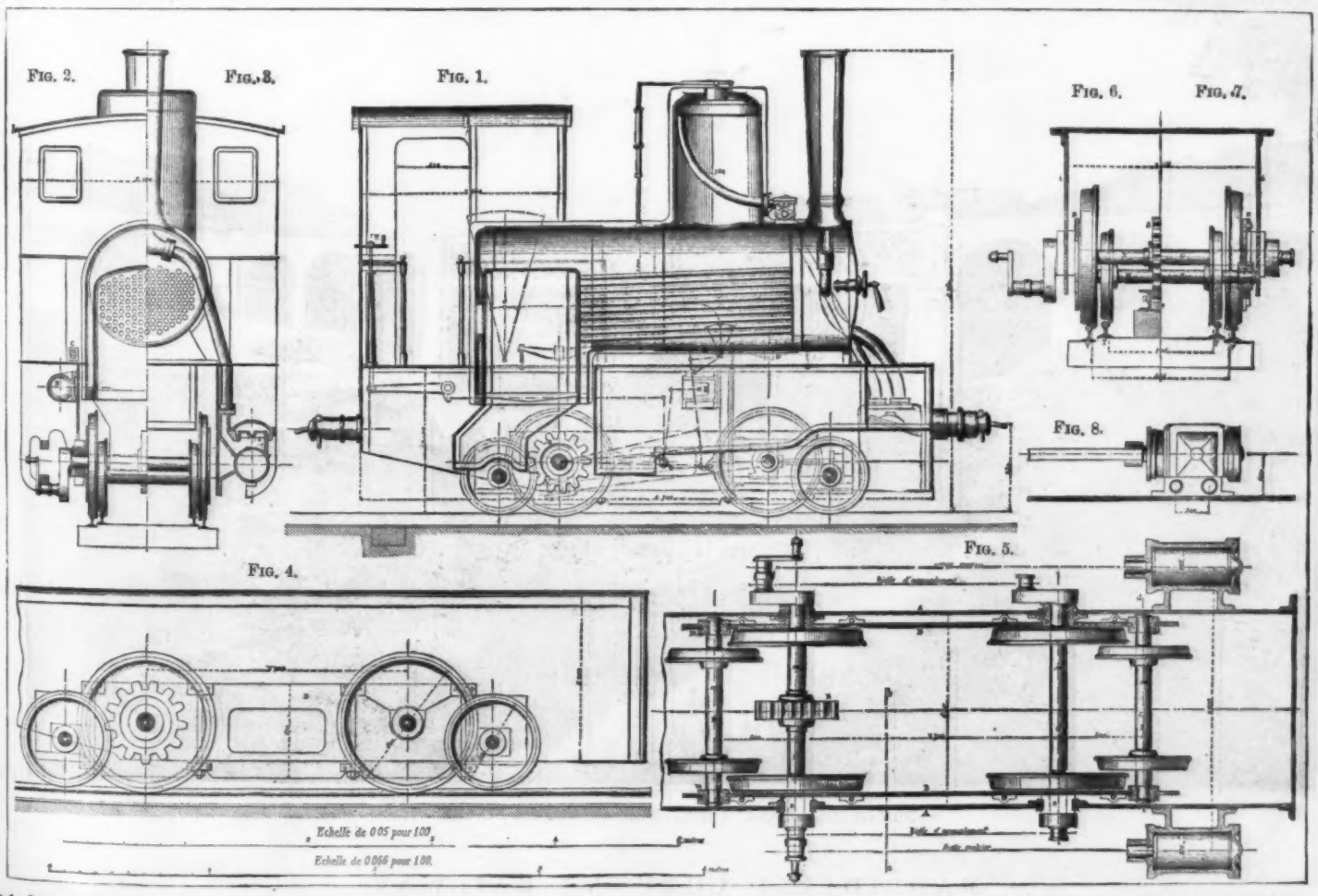
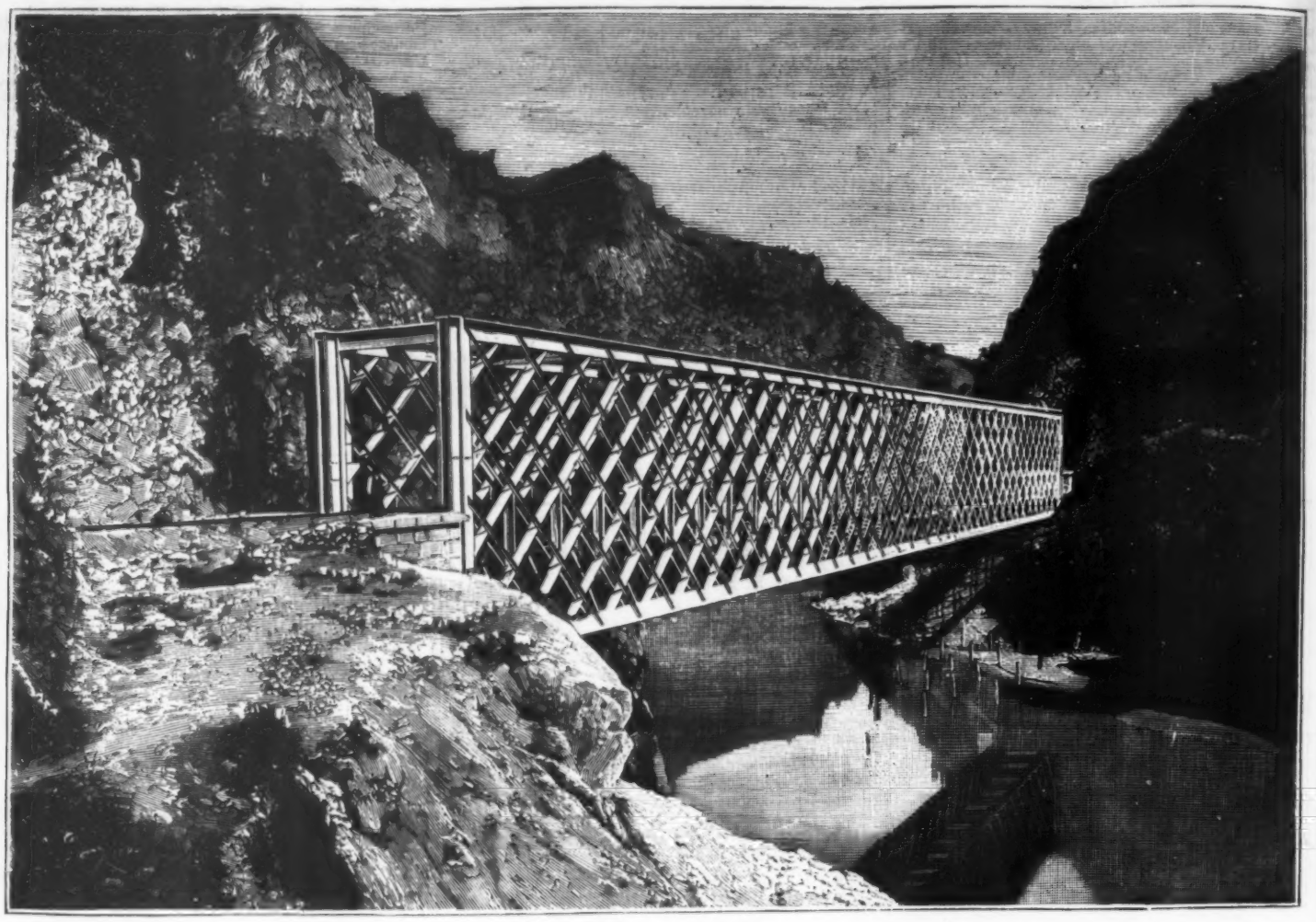
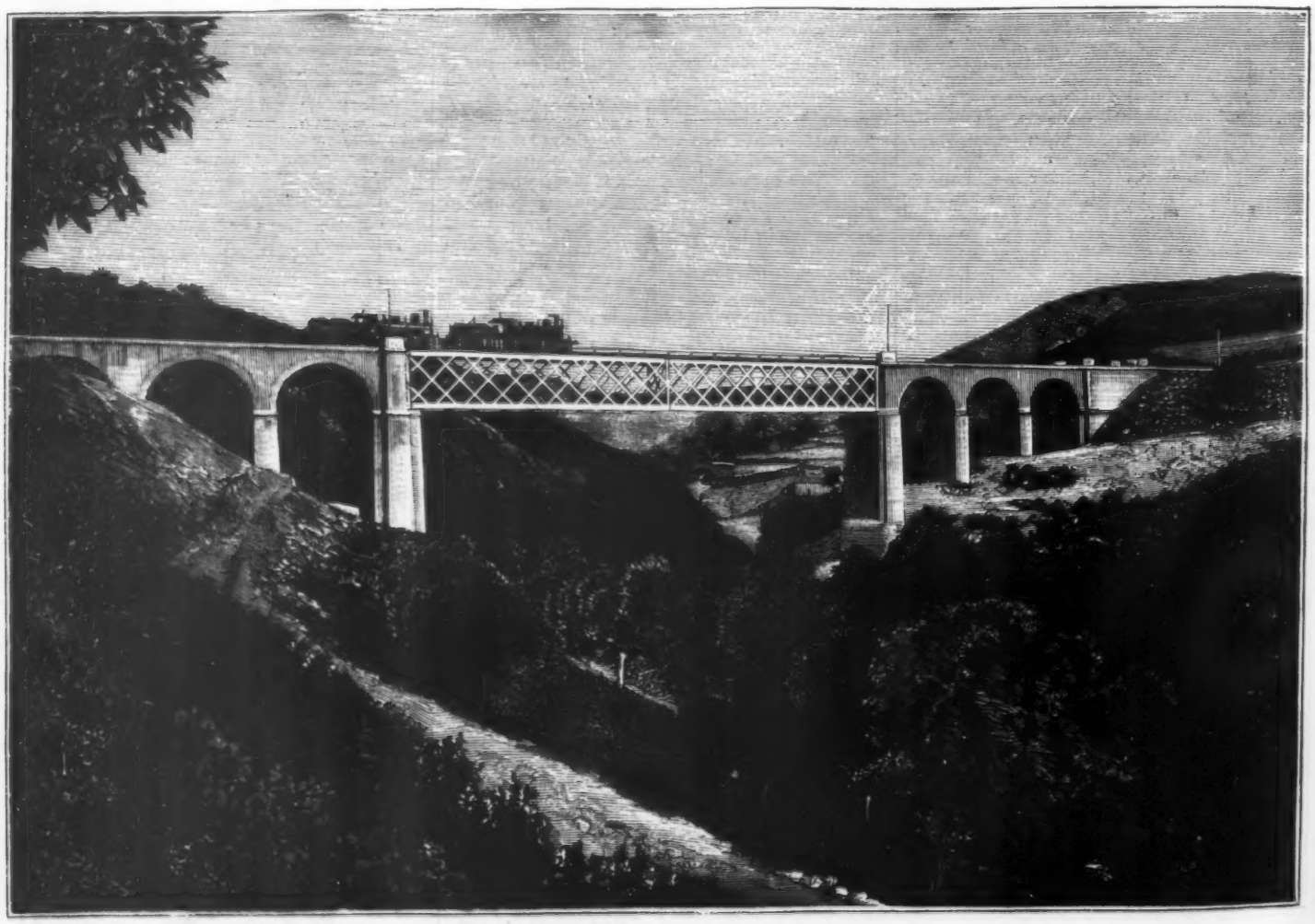


FIG. 1.—Longitudinal Section. Scale of 0·05 to 1.—FIG. 2.—Section through the Fire-box. Scale of 0·05 to 1.—FIG. 3.—Section through the Smoke-box. Scale of 0·05 to 1.—FIG. 4.—Longitudinal section through the Frame. Scale of 0·066 to 1.—FIG. 5.—Horizontal section of the Frame. Scale of 0·066 to 1.—FIG. 6.—Section through *ab*.—FIG. 7.—Section through *cd*. Scale of 0·066 to 1.—FIG. 8.—Plan view of a Cylinder. Scale of 0·066 to 1.

NARROW GAUGE RACK AND PINION LOCOMOTIVE.



BRIDGE OVER THE RIVER SIL.



BRIDGE AND VIADUCT OVER THE ARROYO DE LINARES.

MADRID AND CORUNNA RAILWAY.

auxiliary wheels, mounted upon the axles, M and P, remain suspended on their bearings, *m* and *p*. But, when a gradient is reached, there come into play the rack, S, and the auxiliary rails, T, which latter are slightly elevated above those of the ordinary track. The pinion, R, engages with the rack, and the auxiliary wheels, mounting upon the rails, T, which form an inclined plane at their extremity, leave the driving and fore wheels suspended.

It results from this arrangement that the pinion, R, obtains its motion from the pistons of the engine and serves alone to drive the engine forward, the auxiliary wheels serving the while merely as bearing points, and the two other wheels performing no other role than that of fly wheels.

In order to take up the wear of the auxiliary wheels the builder, Mr. Hagans, has rendered the bearings, *m* and *p*, movable. When the rim has diminished in thickness, as a consequence of prolonged use, the bearings may be keyed to their upper part so as to lower the auxiliary axles.

The locomotive is provided with a four-block brake which the engineman can lock or unlock at will by means of a hand-wheel, E, placed within easy reach. The blocks, which act upon the driving and fore wheels, are likewise actuated by a steam piston, H, which is made use of when an accident chances to occur while the engine is ascending an incline. The brake serves also to slacken speed while descending a gradient.—*Annales Industrielles.*

OPENING OF A GREAT RAILWAY IN SPAIN.

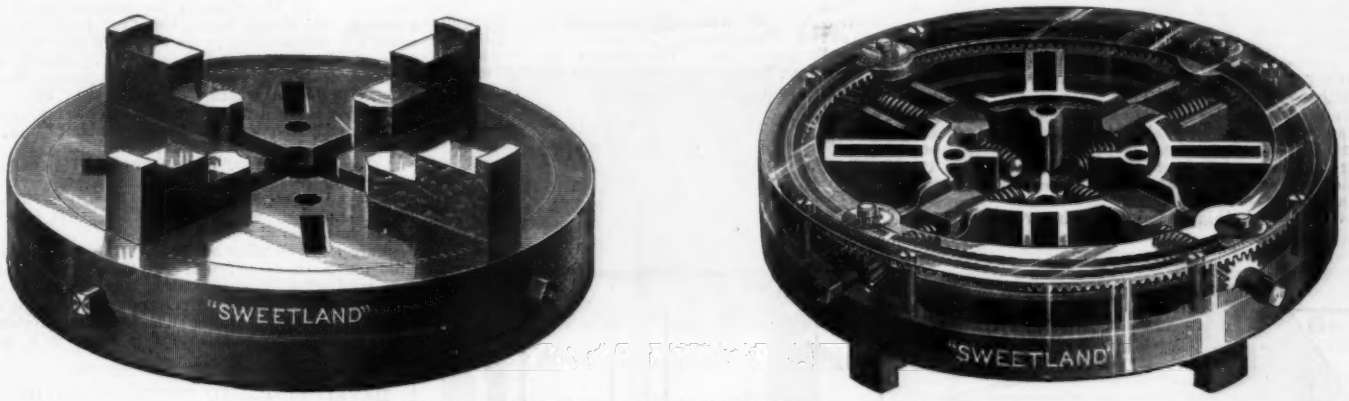
THE rapid progress that Spain is making in modern arts and industries is evidenced by the recent opening, Sept. 4th, of the new Northeast Railway from Madrid, the capital, to Corunna, on the Bay of Biscay, a distance of a little over 500 miles. Several important cities are united to Madrid by this railway, such as Avila, Valladolid, Palencia, Leon, Orense, Lugo. The railway passes through mountainous regions where the work of construction was very expensive and difficult, involving the building of many viaducts, bridges, and tunnels. The latter have an aggregate length of about 18 miles. Among the notable structures is the iron bridge of Cobas, over the river Sil, of which we give opposite an illustration. We also represent the viaduct and bridge of Linares, over the water way of that name. The Chief Engineer of this railway is Mr. Meliton Martin. Our engravings are from *La Ilustracion*, of Madrid.

THE SWEETLAND CHUCK.

THE design of the improvement is to make the chuck independent as well as universal, thus combining two chucks in one. In the recess underneath the rack are the cam blocks, beveled to correspond with the bevel recess in the rack. The cam blocks are held in place by the convex spring washers, which allow them to be moved to or from the center without disturbing the nuts, the friction being sufficient to hold them in place. When moved to the outer portion of the rack they connect the gearing, making the chuck universal; and when moved inward they disconnect the gearing, thu making each screw independent. The advantage of making each screw independent, without disconnecting the others from the gearing, is a feature not combined in any other chuck, and is an improvement fully appreciated by the mechanic when adjusting the jaws for eccentric, concentric, or universal work. For instance, the chuck having been used independent, the workman wishes to change to universal, the jaws are moved inward until the outer end is true with the line on face of chuck; now, each screw can be engaged with the rack separately by sliding the cam block inward. If one jaw is found to be out of true it can be disconnected and reset, leaving the others in mesh undisturbed.

This chuck has a large hole in center, and will allow a drill or reamer to pass through work without injury to face of chuck.

These chucks are furnished without the combination when so ordered, and when thus supplied are universal only, and they are known as the "Horton Style," made by Sweetland & Co., New Haven, Conn.



THE IMPROVED SWEETLAND CHUCK.

THE NORDENFELT GUNS IN ACTION.

THE 22d Middlesex Volunteers (Central London Rangers), under the command of Lieutenant-Colonel W. J. Alt, were in the camp at Aldershott, in August last, for their annual training, throughout the week, and were accompanied by the Nordenfelt machine-gun battery, which belongs to the corps. This was by special permission of his Royal Highness the Commander-in-Chief. It is well known that General Lord Wolseley is greatly in favor of the use of machine-guns in the field, and Lieutenant-Colonel Alt was therefore directed to furnish daily as well as detailed reports of all work done with the guns during the time the corps was in camp. Experiments were made with the view of determining the extreme effective range of the guns, as also at what distance from the enemy they could be brought into action; also whether it was possible to use smokeless powder, the smallest number of men required to work each gun, and all the practical information it was possible to collect regarding the use of machine-guns in the field. The drill, compiled by Captain R. H. Armit (late Lieutenant R.N.), who was in command of the guns, was also thoroughly tested. This was the first occasion on which machine-guns have been worked in this country in conjunction with troops, and the experiment has been watched with great interest, not only by the members of the Volunteer Force, but also by the military authorities. We therefore give two illustrations of the Nordenfelt guns in action at Aldershott; one showing them in the fighting line, with skirmishers between the guns in front of the action; and the other representing the men attached to the guns in a defensive attitude prepared to receive cavalry. In the first mentioned illustration, the men serving the gun are behind it, mostly engaged in filling the receivers with cartridges. Each gun, worked by nine men, is estimated to do the service in action of three hundred men acting in line as infantry. The gun has five barrels, discharging showers of the ordinary cartridges of Martini-Henry rifles, and is worked with extraordinary rapidity. Its front is protected by a plate of the finest steel, a quarter of an inch thick.—*Illustrated London News.*

THEY are talking of bridging the Mississippi at the Slaughter House, New Orlans, where the river is 2,400 feet wide. An engineer proposes seven spans of 300 feet each, one to be a draw. The piers are to be creosoted piles, capped and cased with iron. The depth of the water is no obstacle, as the piles can be spliced. The estimated cost is $13.000,000.

THE NORDENFELT GUNS IN ACTION.

ACHROMATISM OF LENSES.

FIGURE 1 shows the bending of a pencil of light when it passes through a dense transparent medium, and shows how its course is changed when the surfaces of the medium are not parallel. As is well known to all, this bending causes those parallel rays which pass through a lens to meet together approximately at a point.

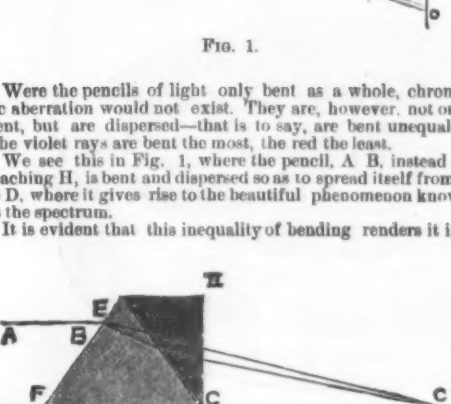


FIG. 1.

Were the pencils of light only bent as a whole, chromatic aberration would not exist. They are, however, not only bent, but are dispersed—that is to say, are bent unequally. The violet rays are bent the most, the red the least.

We see this in Fig. 1, where the pencil, A B, instead of reaching H, is bent and dispersed so as to spread itself from C to D, where it gives rise to the beautiful phenomenon known as the spectrum.

It is evident that this inequality of bending renders it impossible that parallel rays passing through a lens formed of one glass shall focus at a point, but causes them, on the contrary, to focus in a series of concentric rings; in fact, in a sort of circular spectrum.

FIG. 2.

This is the defect known as chromatic aberration. Newton pronounced it incurable. He had, strange to say, overlooked the fact that with different transparent media the degree of dispersion is not proportionate to the angle of refraction or bending. For example, flint and crown glass refract an average ray to about the same extent, but the former disperses or splits up the ray to about double the extent that the latter does. It is thus possible to correct the defect. A lens is so constructed that each ray is first bent far more than is required by a crown glass lens. To this is added a flint glass lens, which, while it only partially straightens, so to speak, the pencil, entirely brings the dispersed rays together again.

We have an illustration of this in Fig. 2. Here we have a

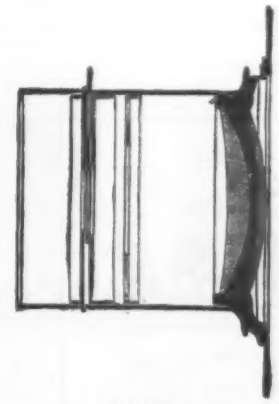


FIG. 3.

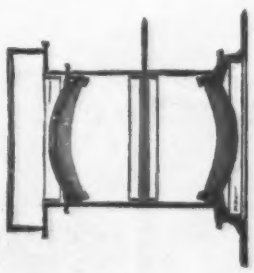


FIG. 4.

double prism, F E G, of crown glass. We see the ray, A B, bent on entering the prism, and were it to issue from it without further treatment it would produce a spectrum. It is caused to pass, however, through a prism, E G H, of flint glass. This does not quite bring it back to a course parallel to its former one, but does cause the dispersing rays to meet each other at *c*, where they again combine and produce white light.

The combination shown in Fig. 2 is to all intents and purposes the one which is used in every achromatized lens. Sometimes glasses of the same name are used in a lens, but in every case the two pieces forming the combination exhibit the quality referred to above; that is to say, they refract or bend and disperse rays in different proportions.

In every figure the glass having the greatest dispersing power is shaded darker than the others.

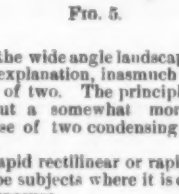


FIG. 5.

Figure 3 shows the wide angle landscape lens. It requires a word or two of explanation, inasmuch as three glasses are used in it in place of two. The principle involved is, however, the same, but a somewhat more perfect result is obtained by the use of two condensing lenses in place of one.

Figure 4 is the rapid rectilinear or rapid symmetrical lens, useful for landscape subjects where it is desirable to give the shortest possible exposure.

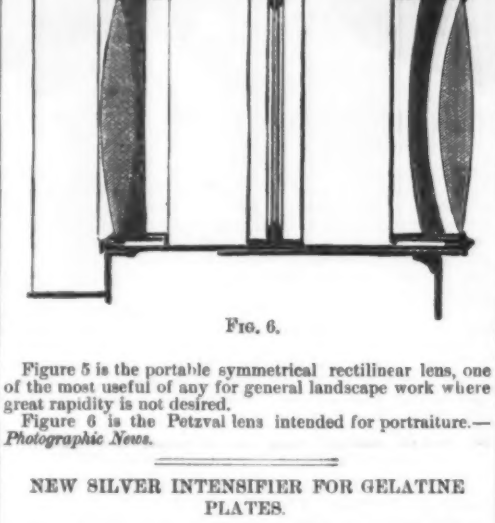


FIG. 6.

Figure 5 is the portable symmetrical rectilinear lens, one of the most useful of any for general landscape work where great rapidity is not desired.

Figure 6 is the Petzval lens intended for portraiture.—*Photographic News.*

NEW SILVER INTENSIFIER FOR GELATINE PLATES.

WM. BROOKS in the *Bri. Jour. of Photo* says: The greatest drawback to gelatine plates has been the want of a proper intensifier after fixing. Many negatives are perfect in every respect except for the want of a little more density to bring them up to proper printing quality. Several methods of mercurial intensification have been put forward; but to no purpose, as the negative changes by light more or less. I myself have never liked mercury in any form, for the reason that when I attempt to alter a negative I never know how much or how little intensity I shall get after its application; and, again, there is always more or less clogging or blocking up of the fine detail, with the result, in nine cases out of ten, of absolute ruin to the negative. I have no doubt that many thousands of negatives have been sacrificed in this way.

I think photographers, both amateur and professional, by practice are more certain than formerly in the early days of the gelatine process in getting their negatives somewhere near the mark as to density. I can now judge pretty well, but at times one is apt to be a little out in judgment and fall a little short; and for the want of a ready and reliable system of intensification, many stick fast. I have made innumerable experiments in this direction, and I was certain that the result must be gained by redevelopment with silver after fixing, as with a wet plate. It is now about six months since I set to work in earnest to find out some method that I could recommend without any drawback, and I now believe that I have accomplished it.

It is a well known fact that to develop a gelatine plate with alkaline pyro. the developer must be much more powerful than we dare use to develop a collodion emulsion plate. In my own work I use a much stronger developer than that usually recommended. I generally use as much as ten minims of liquor ammonia in my developer, well restrained with bromide of ammonium; and, by being able to use such a powerful developer, it occurred to me that, to gain the desired end, we must work in the same direction as regards an intensifier, and I found my surmizes correct.

Some years since I tried other fixing and clearing agents than hyposulphite of soda, as when this salt was used it was a risk to use silver and pyro. afterward. I have employed cyanide of potassium with success at times, but I found the films were not always in the proper condition. At one time I also used sulphocyanide of ammonium. This, too, had certain drawbacks, and it required a great deal of washing to get rid of it; but there was a slight gain over hyposulphite of soda, as the film did not stain nearly so much on the application of pyro. and silver. But with all this it was very slow work, and something was always wanting.

With the intensifier that I am about to propose I find it very easy to get local intensity on such parts in just the same way as we used to do with wet plates, namely, by pouring the developer on and off the place that may require it. I am also able to intensify the mere ghost of an image to good printing density with but very little trouble, provided the shadows are free from deposit and quite clear. The slightest veil in these parts comes up with the image, and a favorable result is not obtained. If the shadows are only slightly veiled, allowing them to remain in the hyposulphite solution for half an hour may clean them; if not, recourse must be had to other reagents, such as perchloride of iron followed by hypo. Care, however, must be taken that its action is even.

Before attempting to intensify the negative all traces of hyposulphite of soda must be eliminated, and there is nothing better for the purpose than the alum and citric acid solution. I make a stock solution, consisting of a saturated solution of common alum, with one ounce of citric acid dissolved in every ten ounces. After the negative has been *well washed* place it in a dilute solution of the above (one part to four of water) and allow it to remain for about a quarter of an hour; then place in a developing measure (supposing a half-plate is being operated upon) about two drachms of the stock alum and citric acid solution, and add to it about two or three grains of dry pyrogallic acid. Give it a shake round to dissolve; then drop in three or four drops of a twenty-grain solution of nitrate of silver, and apply to the plate, holding the latter on a pneumatic holder and pouring off from alternate corners. If the film repel the solution, just run the finger or a brush kept (clean) for the purpose over the repellent portion of the film. This is very energetic, and the alum in the solution keeps back any trace of our enemy, hypo., that may be lurking about. I find it is not satisfactory to work in a dish when intensifying, as the back of the plate gets very cloudy, and sometimes as the solution gets brown it apparently discolors the film, but that all comes right afterward. Silver is added according to the density required. When sufficient density is obtained, well wash and place for about five or ten minutes in the hypo. fixing bath; well wash again, and place in the dilute alum and citric solution. This will remove all color, and if there were any greenish yellowy look about the negative before intensification it will be found to have all disappeared, and the result is a negative in all respects equal to the finest wet plate.

Care must be taken not to work the alum and citric bath too much, so as to foul it with the hypo. I allude to the one used before intensification. I am sure if this be worked fairly it will be found perfect and certain in its action. I have never heard of this system being put forward before, and trust it will be as useful to others as it has been to myself.

DEVELOPING AND INTENSIFYING GELATINE NEGATIVES.

IT is well known that negatives developed with the alkaline pyro. developer are usually of a very non-actinic color. In many cases this is a decided advantage, and, in conjunction with the facility with which the color of the deposit can be altered or modified, forms one of the most valuable characteristics of pyrogallic development.

A negative which has been slightly underdeveloped, although apparently thin and weak, will often yield brilliant and vigorous prints on albumenized paper, owing to the insensitiveness of the chloride of silver to the yellow rays. On the other hand, in negatives which have been more fully developed, the yellow color, which would retard the printing too much, is best removed. This can easily be effected, and the negative made similar in color and printing qualities to a wet collodion negative, by the following modification of Mr. Cowell's formula:

Alum	1 ounce.
Citric acid	1 "
Sulphate of iron	3 ounces.
Water	20 "

After the negative has been fixed and slightly rinsed the above solution is poured upon the plate and the effect watched until the desired result is obtained, which will be in a few seconds; the negative is then well washed and dried in the usual way. The addition of the sulphate of iron not only improves the color of the negative, but it also entirely prevents the reduction in density which would otherwise take place.

In practice I find it a convenient plan to make two stock solutions. The first consists of the acid and alum solution in the proportions given above; the second is simply a saturated solution of sulphate of iron. When required for use, one part of the latter is added to four or six parts of the solution of alum and acid. For negatives which require slightly intensifying, the larger proportion of iron solution should be used. If further intensification be desired, it is only necessary to add a few drops of a twenty-grain solution of nitrate of silver to the mixed solutions, when the negative can be intensified, locally or otherwise, as easily and safely as a wet collodion plate. There is no danger of staining the film, provided the negative has been well washed after fixing to remove the hyposulphite of soda.—*B. J. Edwards, in Br. Jour. of Photo.*

IMPROVED AUTOMATIC CAMERA.

PROFESSOR STEBBING says:

"With my new automatic camera a fraction of a second suffices for the exposure, and by the modification I have introduced of having rollers upon which can be wound sufficient film or sensitized paper, fifty or sixty proofs can be made without opening the camera. Dry plates can also be employed. The size chosen is 2¼ x 2⅜ for dry plates, and 2¼ x 2⅜ for films.

In form the apparatus resembles a stereoscope, bearing a lens of four inches focus, made by one of our opticians. On the top is fixed an instrument called a "finder." By placing the eye to the round hole one can see all the landscape as reflected by the lens upon the sensitive material in the interior. On each side of the "finder" are two knobs attached to the rollers, to which the film or sensitized surface is fixed. A ratchet catch is so placed that at every turn of the cylinder or roller a noise is made to warn the operator that another piece of film is ready for exposure. The film in moving from one roller to the other passes before a sheet of plate glass, but without touching it, so as to avoid scratches or line marks in the finished negative. It is on the back surface of this glass plate that the focus of the lens has been accurately adjusted. In order that the sensitized surface should have perfect contact with the surface of this glass when required, a movable board covered with black cloth has been so adjusted behind that by turning a screw the board advances and pushes the film against the glass plate during exposure; when this is terminated, and to permit the film to be changed, the board is withdrawn by means of the before-mentioned screw. On one side of the board are placed two sharp points, which make holes in the film to enable it to be cut up into small pieces for the convenience of development.

In order to expose either film or sentitized paper the material is cut into bands of one or two yards in length by two

and a-half inches wide. The end of the band is put into the slit of the left hand roller and fastened by the mechanical means provided. It is then wound upon this roller, and the other end is attached to the right-hand roller by the same means. The back of the camera is now put in, and all is ready for work. When the landscape is chosen, the screw in the back of the camera is turned to the left. This pushes the sensitized surface against the glass and insures complete sharpness. For another exposure the screw is reversed, and the right hand roller can be turned until the "click" is heard. The sensitized material being now pressed against the glass, is ready for another exposure, and so on until the band is completely used. To employ dry plates it suffices to take out of the camera the frame bearing the glass, and introduce the dark slide holding the plate into its place. The little negatives are so sharp that they will bear to be enlarged if required.

PHOTOMETRIC MEASUREMENTS AT THE INTERNATIONAL EXHIBITION OF ELECTRICITY AT MUNICH.

THE dark chamber devoted to photometric measurements at the recent Munich Exhibition of Electricity was a long and narrow hall, as shown in perspective in Fig. 1 and in plan in Fig. 2.

This chamber contained two photometric rules, AB and BC, 6 and 12 meters in length. At A there could be placed a normal candle, I, or an Argand gas-burner, III (Prof. Rudorff's No. 2 model). At II there was a gas-burner having a 1 mm. aperture, and a constant height of flame. At B there was placed a Siemens intensitive burner or an incandescent lamp, IV, and at VI. the arc lamps. *a* and *b* were two Bunsen photometers movable on the rules or measuring-rods, and C^1, C^2, and C^3 were counters for the gas-burners, in front of which stood the principal regulator, R.

For making observations, the operators were five in number, B^1, B^2, B^3, B^4, and B^5.

The exhibitors having once ascertained that their apparatus were operating normally, a provisional trial was made as to the constancy of the lamps' luminosity. Observers B^1 and B^3 compared, through four observations each, the luminous intensities at positions III and IV, or V and VI. Then B^2 and B^4 made a comparison of the same sources. After a short time the observations were repeated. During this time B^5 was observing the gas-regulator, R, and was thus verifying the constancy of the pressure. The measurements, properly so called, were afterward made by one or the other of the following methods, according as it was a question of incandescent or of arc lamps.

A.—Incandescent Lamps.—The unit of light adopted was the normal English spermaceti candle (I), having a flame 45 mm. in height.

Before and after each series of experiments a comparison was made, by means of the photometer, *a*, on the rule, AB, between this candle and a single-aperture gas-burner (II) supplied by a one-candle counter, G^1. During this experiment of about two minutes the constancy in the intensity of the gas-burner was controlled by means of an Elster regulator, R. The single-aperture burner, II, was afterward substituted for the candle, and was compared with the Argand gas-burner, III, supplied by a 16-candle counter, G^3.

After removing the burner, II, the Argand burner, III, was compared with the incandescent lamps, IV. Lamps of the Edison type had the plane of their carbons perpendicular to the photometric rule.

Sources II, III, and IV were burning during the entire duration of the observation, and, when they were not in use, were hidden by perfectly opaque screens.

According to the mode of experiment adopted, observers B^1 and B^3, each made four observations on sources II and III, and B^2 and B^4 did the same with IV and III. The observers afterward changed places, so that B^1 and B^3 compared IV and III, and B^2 and B^4 compared III and II, always making four observations each. B^5 noted, before and after each series of observations, the state of the Elster pressure-regulator and that of the three counters, as well as the duration of the series of observations. In addition to this determination of the intensity of the lamps, there was also determined what proportion of light was emitted when the lamp was revolved around a vertical arc at 0°, 45°, and 90° relative to its first position. B^1 and B^2 made such determination at the angles 0°, 45°, and 90°, and B^3 and B^4 repeated it in inverse order at 90°, 45°, and 0°. B^5 made the controls as before.

B.—Arc Lamps.—The sequence of operations up to the comparison of the Argand burner was the same as described in the preceding section.

The Argand burner was afterward compared with the Siemens intensitive burner, V, supplied by a 30-burner

FIGS. 2 AND 3.—PLAN OF THE DARK CHAMBER.

counter, and then the Siemens burner was compared with the arc lamp which was upon the same plane, by means of the photometer, *b*, on the rule, BC. In this case again the foci were burning all the while that the observations were being made and were covered with screens when they were not being employed.

Observers B^1 and B^3 compared sources II and III, and then III and IV (always through four observations), and afterward B^2 and B^4 compared V and VI, this latter focus at first uncovered and then with a globe.

The observers subsequently changed places so that B^1 and B^2 compared VI and V (the first focus uncovered and then with a globe), and B^3 and B^4 operated upon V and III, and afterward upon III and II.

B^5 made the controls, as we have just stated in speaking of incandescent lamps.

In addition to these determinations of the intensity of the arc lamps in a horizontal direction, there was also determined what proportion of light was emitted at the angles of 0°, 30°, and 60°, starting from the horizontal, as well as in special directions indicated by the manufacturers. For this purpose there was employed a mirror, S (Fig. 3), fixed at the extremity of the rule, BC, and which could be made to assume a given angle around a horizontal axis. The arc lamp, VI, was placed at different fixed heights in such a way that the rays, *b*, emitted in the direction of the angles mentioned above, fell, after reflection, upon the photometer. The coefficient of the mirror's reflection was determined by a preliminary trial.

The determination of the intensity per unit of surfaces of the different sources was left out of consideration on account of the length of time that it requires and its small practical importance.—*La Lumière Electrique.*

THE ELECTRIC RAILWAY AT BRIGHTON, ENGLAND.

THE line was constructed very hurriedly; how hurriedly may be judged from the fact that the line was laid, the car, dynamo, and motor built, and the engine and dynamo fixed in their places in about 18 days. The generator is a Siemens D^5 machine, having an E.M.F. of 55 volts, and giving a current of 18 amperes at 1,700 revolutions per minute. One of Crossley's gas engines of 2 horse-power is used to drive the dynamo. It has two fly-wheels, and runs at 160 revolutions per minute. The dynamo, which is used on the car as a motor, was constructed by Mr. Volk; it weighs about 2¾ cwt., and runs at 700 revolutions per minute. The pulley is connected by means of a belt to a countershaft, from which another belt runs to another pulley fixed on one of the axles. The pulley of the motor is 5 in. in diameter, that on the countershaft 10 in., and that on the axle 12 in. The speed of the car up an incline of 1 in 100 is about 5 miles an hour, the return journey down the incline being made at the rate of ten miles an hour. The car carries twelve passengers, exclusive of the driver; it has carried as many as sixteen persons, however. It is lighted at night by a 20 candle-power Swan lamp.

Reversal is effected by means of a commutator switch, which introduces a number of resistances into the circuit before breaking it, thus greatly diminishing the sparking. The same lever which actuates this switch also alters the lead of the brushes, of which but one pair is used. The wear of these brushes has been so slight that they only required to be removed after three weeks' nearly continuous running.

The track is about a quarter of a mile long, and rests on the shingle; ordinary flange rails and longitudinal sleepers are used. The rails are connected by No. 8 copper wire loops bolted on with three-eighths inch bolts.

On the last Bank Holiday, 6th August, says the *Electrician*, the car ran for eleven hours without a break. During this time it conveyed 1,200 passengers and covered fifty miles. Since that date it has continued running every day without interruption up to the present time. The loss of current even during a wet day does not, we are told, exceed 10 per cent., and in dry weather is less than 5 per cent. The rails alone are used as conductors, and the wet weather has not interfered with the working in the least.

The following table gives some details concerning the current, weight of car, etc., which are interesting:

Engine, 2 horse-power nominal, about	3½ indicated.
Current	18 amperes.
E.M.F.	55 volts.
Weight motor	2¾ cwt.
" car	7 "
Load 12 persons	1 ton.
Gradient	1 in 100.
Speed mean	7 miles per hour.
Daily journey	25 to 30 miles.
Daily average number of passengers	350.

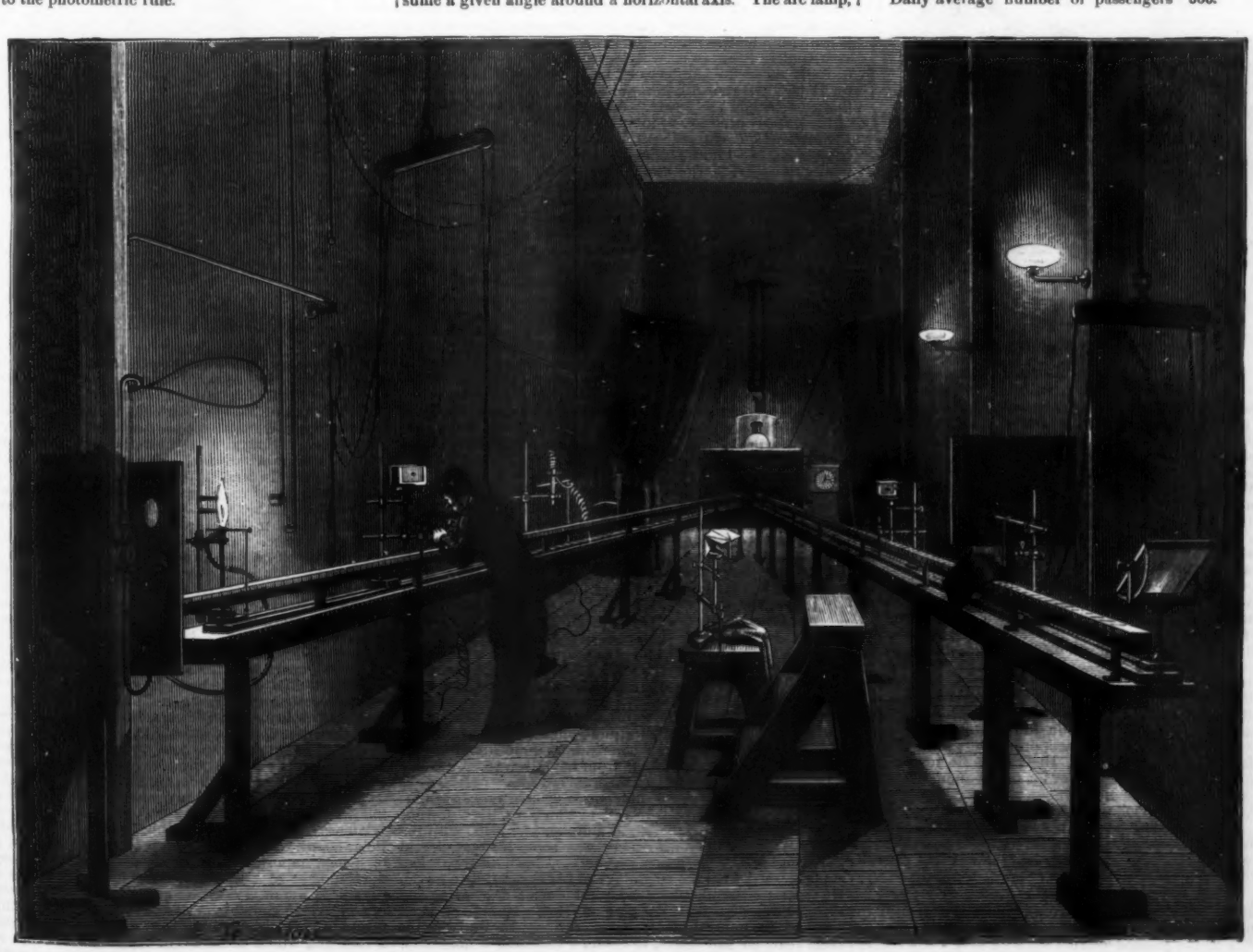


FIG. 1.—DARK CHAMBER FOR PHOTOMETRIC MEASUREMENTS AT THE MUNICH EXHIBITION.

Application is now being made to extend the system the whole front of Brighton under the Esplanade wall—a distance of two miles—and to run cars in both directions every 10 minutes; and also to have an electric hoist to convey passengers up the face of the eastern wall, a height of 62 feet.

The cost of carrying 12 passengers 60 journeys of half mile each, *i. e.*, 12 passengers 30 miles, or one passenger 360 miles is stated to be as follows:

Gas, 10 hours at 3d	2s. 6d.
Oil and waste, total.....	0s. 8d.
Conductor..	3s. 4d.
Laborer to clean and attend to engine, repair shingle track, etc	4s. 2d.
Depreciation, 15 per cent. on £500, say	5s. 0d.
	15s. 8d.

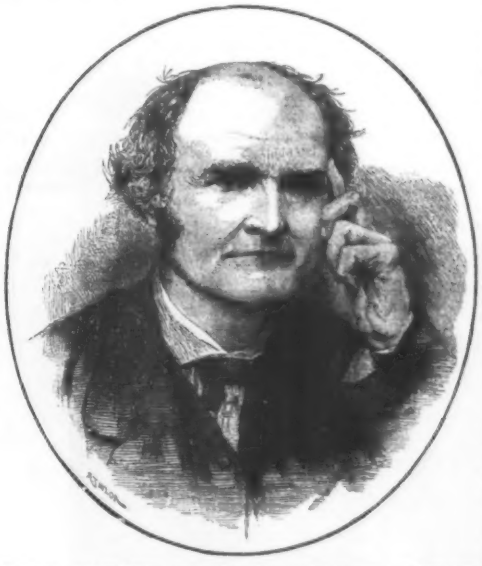
or a trifle over ¼d. per mile. As the car at present runs for five minutes only and then stands five minutes, its carrying capacity can be multiplied by two, in which case the only increased expense would be the cost of 50 per cent. more gas, the cost in wages remaining the same, so that the cost is only a trifle over ¼d. per mile per passenger, supposing it runs full every journey.

A LOW RESISTANCE CALLAUD CELL.

IN the *Beiblatter*, Herr Torquem describes a Callaud cell having a very low resistance. A glass vessel 0·16 m. wide and 0·23 m. high, containing 5 liters, is provided at the bottom with a tube closed by a cock, into which a glass tube, bent upward, is placed. At the top of the cell is a brass cross resting on the edge, in which is placed a spiral coil of thick sheet zinc weighing 3 kg. A funnel passes through this spiral. On the bottom of the cell lies a copper plate, to the center of which is attached a copper wire passing up through an inverted lamp chimney of glass. The cell is filled with a fifty per cent. solution of pure crystallized sulphate of zinc; in the lamp chimney are placed crystals of sulphate of copper, after a small quantity of the above solution of sulphate of zinc mixed with a saturated solution of sulphate of copper has been poured in. Small strips of zinc hanging down from the brass cross into the liquid prevent the deposition of copper on the zinc spiral. The resistance of the cell with a sixty per cent. solution of zinc is 1·58 ohms A certain quantity of liquid is drawn off daily into two flasks filled with granulated zinc, which precipitates the copper, and the liquid can then be poured back into the cell through the upper funnel.

PRESIDENT OF THE BRITISH ASSOCIATION.

THE fifty-third meeting of the British Association was held at Southport, England, on the 19th of September last.



PROF. CAYLEY, PRESIDENT OF THE BRITISH ASSOCIATION.

The Sadlerian Professor of Mathematics at Cambridge University, Dr. Arthur Cayley, F.R.S., D.C.L., LL.D., presided. The eminent mathematician is a son of the late Mr. Henry Cayley, who was a Russian merchant in London, and is related to the family of Sir Digby Cayley, Bart., of Brompton, Yorkshire. He was born at Richmond, Surrey, in 1821, and was educated at King's College, London, and at Trinity College, Cambridge, where he took his B.A. degree in 1842, winning the double mathematical honor of Senior Wrangler and Smith's Prizeman. He was elected, successively, Scholar and Fellow of Trinity College. In 1849 he was called to the Bar at Lincoln's Inn, and has since practiced as a conveyancer. When the Sadlerian Professorship was established, in 1863, Mr. Cayley was elected to be the first holder of this Chair; and it was in 1875, by the provisions of a College Statute enabling a Professor or Public Lecturer of the University to be chosen for a College Fellowship, that he became a Fellow of Trinity. Professor Cayley received the honorary degree of Doctor of Civil Laws from the University of Oxford in 1864, and next year that of Doctor of Laws from the University of Dublin; in 1875 the University of Leyden conferred upon him, most appropriately, that of Doctor of Mathematics and Physics. He is also a Corresponding Member of the Institute of France for the Section of Astronomy, a Fellow of the Royal Society of London, of the Royal Astronomical Society, and of several other scientific bodies, to whose discussions he has contributed many valuable papers.

The portrait is from a photograph.—*Illustrated London News.*

A VESSEL constructed of paper was recently launched in St. Petersburg. She is driven by steam, and her dimensions are, length 25 ft., greatest width 5 ft., with only a few inches draught of water. The recent trials with paper for railway *materiel* has led to the present experiment.

ADOLF ERIK NORDENSKJOLD.

FEW men have done more varied and real service for science than Baron Nordenskjold, whose portrait we are pleased to include in our Gallery of Scientific Worthies. The present seems an appropriate time to do so, when Nordenskjold has crowded the labors of half a lifetime by recounting the story of his greatest achievement, and put the finishing touch to centuries of effort. Baron Nordenskjold is known to most as the successful Arctic explorer and navigator, but his claims to be regarded as a worthy of science rest on a much wider basis.

Adolf Erik Nordenskjold was born at Helsingfors, the capital of Finland, on November 18, 1832, the third in the order of seven children, four brothers and three sisters, all of whom, with the exception of a sister who died young, still survive. His parents were Nils Gustaf Nordenskjold, a well known naturalist, chief of the mining department of Finland, and Margareta Sofia von Haartman. The race from which Nordenskjold sprang had been known for centuries for the possession of remarkable qualities, among which an ardent love of nature and of scientific research was predominant. Its founder is said to have been a Lieut. Nordberg, who was settled in Upland about the beginning of the seventeenth century. His son, Johan Erik, born 1660, changed the name to Nordenberg. He died in 1740, leaving two sons, Anders Johan and Carl Frederik, both of whom, though the latter was only lieutenant, were elected members of the Swedish Academy of Sciences when it was founded in 1739. Both were ennobled in 1751. Carl Frederik is the common ancestor of the families bearing the name of Nordenskjold now living in Sweden and Finland. One of his many remarkable sons, the third in order, Col. Adolf Gustaf Nordenskjold, became owner of Frugord in Finland. This property, situated in a forest-crowned valley in the department of Nyland, is still in the possession of the Nordenskjolds. Here Col. Adolf Gustaf Nordenskjold built a pecular residence, the middle of which is taken up with a hall two stories high, round the upper part of which runs a broad gallery in which collections in natural history are arranged. His youngest son, Nils Gustaf, was born in 1792. After passing his examination in mining at the University of Upsala he was for several years a pupil of Berzelius, with whom he formed the warmest friendship, which was only broken off by death. Nils Gustaf, early known as a distinguished mineralogist, was appointed a government inspector of mines in his native country, and by means of liberal grants of public money was enabled to undertake extensive foreign tours, which brought him into communication with most of the eminent mineralogists and chemists of the day in England, France, and Germany. After three years of foreign travel he returned to Finland, and was promoted in 1824 to be chief of the mining department, and devoted thirty years of restless activity to the improvement of that important branch of the industry of his native land. He traveled through Finland in all directions in the prosecution of his untiring mineralogical and geological researches. His travels extended as far as the Ural. He published his views, discoveries, and experiments in many scientific periodicals and in several independent works, and a large number of minerals discovered by him afford evidence of his keen research. He was made Councilor of State, and obtained many distinctions for his scientific services from the sovereign and from learned bodies. On February 21, 1866, he ended his active life at Frugord, and was laid to rest in his father's grave.

Adolf Erik while yet a boy was an industrious collector of minerals and of insects, and was permitted to accompany his father on his tours, acquiring thus early the keen eye of the mineralogist. After studying for some time with a private tutor he was sent to the gymnasium at Borgo, where, as at similar institutions elsewhere, there then prevailed, as he tells us in the autobiographical sketch which he wrote for Bejer's "Swedish Biographical Lexicon," an almost unlimited freedom, the teachers taking no oversight whatever of the pupils' attention to their studies.

Nordenskjold entered the University of Helsingfors in 1849, devoting himself chiefly to the study of chemistry, natural history, mathematics, physics, and, above all, of mineralogy and geology. "Already, before I became a student," he writes, "I had been allowed to accompany my father in mineralogical excursions, and had acquired from him skill in recognizing and collecting minerals and in the use of the blowpipe, which he, being a pupil of Gahn and Berzelius, handled with a masterly skill unknown to most of the chemists of the present day. I now undertook the charge of the rich mineral collection at Frugord, and, besides, during the vacations made excursions to Pitkeranta, Tammela, Pargas, and others of Finland's interesting mineral localities. By practice I thus acquired a keen and certain eye for recognizing minerals, which has been of great service to me in the path of life I afterwards followed."

After passing his candidate examination in 1853, Nordenskjold accompanied his father on a mineralogical tour to Ural, devoting most of his attention to Demidoff's iron and copper mines at Tagilsk. Here he planned an extensive journey through Siberia, but the breaking out of the Crimean war put a stop to it.

"After my return," says Nordenskjold, "I continued to prosecute my chemical and mineralogical studies with zeal, and wrote as my dissertation for the degree of Licentiate a paper 'On the Crystalline Forms of Graphite and Chondrodite,' which was discussed under the presidency of Prof. Arppe on the 28th of February, 1855. The following summer I was employed on a work of somewhat greater extent —'A Description of the Minerals found in Finland,' which was published the same autumn. Various short papers in mineralogy and molecular chemistry were printed in *Acta Societatis scientiarum Fennicæ;* I also published, along with Dr. E. Nylander, 'The Mollusca of Finland' (Helsingfors, 1856), as an answer to a prize question proposed by one of the faculty. In the interval I had been appointed Curator of the Mathematico-Physical faculty, and had obtained a post at the Mining Office as mining engineer extraordinary, with inconsiderable pay, and an express understanding that no service would be required from me in return. A salary was also attached to my curatorship."

Nordenskjold, however, did not long hold these appointments, having incurred the wrath of Von Berg, the Governor of Finland, for being present at a dinner at which, with the thoughtlessness of youth, there was some liberal talk and free singing. This was in November, 1855, and Nordenskjold resolved to take advantage of his rustication to travel. He went to Berlin, where he staid during the spring and early summer of 1854, working in Rose's laboratory at researches in mineral analysis. Returning to Finland the same year, he had hoped to obtain a traveling scholarship, meaning to devote himself to Siberia, but was disappointed. He, however, obtained a stipend for a line of study through Europe in 1857. Before leaving he attended the Promotion Festival of that year, where he was to take his Master's and Doctor's degrees. At the Festival there was more liberal talk, which Von Berg construed into "high treason," and Nordenskjold thought it advisable to leave Finland for a time. He crossed over to Sweden, where he ultimately became naturalized, and rose to eminence both in public life and as a worker in science. Since 1862, however, Nordenskjold had been allowed to go to Finland as often as he pleased, and would have been, in 1867, appointed Professor of Mineralogy in the University of Helsingfors, he had been able to promise to abjure politics, which he could not do entirely. By this time (July 1, 1863) he had married a Finnish lady (Anna Mannesheim, daughter of ex-President Count Carl Mannesheim). In 1858 Nordenskjold took part in the first expedition to Spitzbergen, organized by Sorell, the head of the Swedish Geological Survey. To these and other voyages of Nordenskjold we referred at some length in vol. xx., pp. 606, 631, and further details will be found in Mr. Leslie's "Arctic Voyage of A. E. Nordenskjold," published by Macmillan and Co. in 1879, to which we are mainly indebted for the details of the present article. On his return from this voyage in the autumn of 1858, Nordenskjold was appointed successor to Mosander in the Mineralogical department of the Riks Museum at Stockholm. Meantime he had been engaged mainly in the practical study of the mineralogy of Scandinavia.

"Immediately after my return to Stockholm I entered on my new employment, and began to work partly at the arrangement of the museum, partly at scientific researches which formed the subjects of several of my papers published either in Transactions of the Academy of Sciences or of the Geological Society. At Prof. Mosander's death, when the rebuilding of the Academy's house had just begun, the mineralogical collection was stuffed into three small rooms, where there was so little space that the exhibition of the collection could not be thought of. The new spacious apartments intended for the Riks Museum were finished in the summer of 1865, and already by the following autumn the arrangement and removal of the collections were so far advanced that the Museum could be opened to the public. It has since been my constant endeavor to enlarge the collection not only by purchases from dealers in minerals, but mainly by visits to the most important mineral localities in Scandinavia, undertaken on account of the Museum, partly by the Intendent himself, partly by Assistant Lindstrom, or by students of mineralogy from the Universities. In consequence of the extraordinary richness of the Scandinavian peninsula in rare and remarkable minerals, the Mineralogical Museum at Stockholm, with the help of the collections, valuable in certain directions, which have existed from Mosander's time, has in this way become one of the most considerable in Europe."

Nordenskjold still continued to travel in search of minerals through various parts of Sweden and Norway. In

ADOLF ERIK NORDENSKJOLD.

1861 he took part in another expedition to Spitzbergen under Torell, and in December, 1862, he crossed on the ice from Sweden to Finland, in order to make some investigations on the formation of sea-ice. In 1864 another expedition was made to Spitzbergen in connection with the measurement of an arc of meridian, and in the following year he was busy with further mineralogical investigations both in Sweden and Finland. In 1867 an agreeable change came in the form of a visit to Paris in connection with the Metric Commission, and the Exhibition of that year gave Nordenskjold an opportunity of making the acquaintance of many eminent men of science. In the summer of 1868 Nordenskjold found himself at the head of an expedition on a much larger scale than any of his previous ones, and partly fitted out at the Government expense. Rich and important scientific collections were brought home, and they reached the highest northern latitude which any vessel could be proved to have attained in the old hemisphere at that time. Among the contributors to this expedition was Mr. Oscar Dickson of Gothenburg, whose name is inseparably connected with Nordenskjold's Arctic researches, and who has continued ever since to contribute to his expeditions with unprecedented liberality. Mr. Dickson, as is evident from his name, is of British origin, his father having been a native of Scotland who many years ago settled in Sweden. Previous to and preparatory for his next expedition, Nordenskjold in 1870 visited Greenland, in company with Dr. Berggren, with results of the greatest value; some of which he refers to as follows:

"The collection of new contributions to the flora of the Polar countries during several preceding geological periods, of special importance for a knowledge of the history of the development of our globe. The discovery in the Miocene basaltic strata of Greenland, at Ovifak, on the island Disko, of the largest known blocks of meteoric iron, regarding the origin of which an extensive scientific controversy has arisen, and which perhaps will at some future time form the starting point for quite a new theory of the method of formation of the heavenly body we inhabit. The large blocks

were brought home the following year by two vessels of war which were sent out to Greenland for that purpose by the Swedish Government, under the command of Baron Von Otter.

"An excursion of some length was made into the wilderness of ice, everywhere full of bottomless clefts, which occupies the interior of Greenland, and which, if I except unimportant wanderings along the edge and an inconsiderable attempt in the same direction in the year 1728, by the Dane Dalager, was now, for the first time, trodden by human foot. I had here an opportunity of clearing up the nature of a formation which, during one of the latest geological ages, covered a great part of the civilized countries of Europe, and which, though it has given occasion to an exceedingly comprehensive literature in all cultivated languages, *had never before been examined by any geologist.* The equipment for the journey was exceedingly defective, because everybody with whom I conversed, who had any knowledge of the circumstances, declared to me that such a journey was impracticable, and that in consequence my preparations were thrown away. It was on this account that I was compelled to return earlier than would otherwise have been the case."

One object of Nordenskjold going to Greenland was to discover whether dogs could be used in Spitzbergen for extensive sledge journeys, with the result that he found that they could not be employed "in long sledge journeys in the regions where no game was to be had."

Nordenskjold had not ceased to take an interest in public affairs, and represented the capital of Sweden in the Diet for 1869 to 1871, during which he managed to bring about some important legislative measures for the better promotion of science. In the Spitzbergen Expedition of 1872–73 Nordenskjold spent the winter in Mussel Bay, the state of the ice having been in an unusually unfavorable condition. Among the results of the expedition Nordenskjold mentions the following:

"The discovery on the Polar ice itself of a dust of cosmic origin, containing metallic nickel-iron; researches by Dr. Kjellman on the development of algæ during the winter night, which at Mussel Bay is four months long; researches on the aurora and its spectrum by Dr. Wijkander and Lieut. Parent, of the Italian Marine; researches by Dr. Wijkander on horizontal refraction in severe cold; a complete series of meteorological and magnetic observations in the most northerly latitude where such observations had up to this time been carried on; the discovery of numerous new contributions to a knowledge of the flora of the Polar countries during former geological epochs; a sledge excursion undertaken under very different circumstances by Palander and myself, whereby the north part of North East Land was surveyed, and a journey, very instructive in a scientific point of view, made over the inland ice of North East Land, etc., etc."

Then in 1875 followed the expedition to the mouths of the Yennissei and Obi, the first of a series which culminated in the circumnavigation of Europe and Asia, of which we have just had such a full and instructive narrative.

Thus no one man has done half so much as Baron Nordenskjold for a scientific exploration of the Arctic regions. The most striking characteristics of his various expeditions have been the small expense at which they were conducted, their modest but carefully considered equipment, the clear and scientific methods on which they were planned, and the wealth and high value of the results obtained. In the intervals between the expeditions, Nordenskjold was by no means idle. Not only was he occupied with his official duties as chief of the Stockholm Museum, but his researches in mineralogy, on the origin and constitution of meteors, on auroræ, and in other important departments, are of the greatest moment. In 1876 he took part as a commissioner in the Philadelphia Exhibition; when he returned on July 1 of that year he stepped on board the vessel that was to take him on his second expedition to the Yennissei.

As to the personal character of Baron Nordenskjold, we need say little; his modesty and geniality are well-known, and his aversion to public display. He has in his adopted country risen to the highest honors, and as a well-earned reward for the success of his last expedition, the King of Sweden, his warm supporter, conferred on him the title of Baron. From scientific societies all over the world he has received honors. He is only yet in his prime; he is even now preparing for another expedition to the shores of Siberia, and we trust he may long be spared to carry on the work in which it would be difficult to find a successor.—*Nature.*

NORDENSKJOLD GREENLAND EXPEDITION.

BARON NORDENSKJOLD has returned, and from Thurso he sent on Sept. 21, 1883, to the London *Times*, the following summary of his results and explorations in Greenland. "An inland ice party started on July 4, from Auleitswik Fjord. When they were 140 kilometers east of the glacier border and 5,000 feet above the sea level, they were prevented by soft snow from proceeding with sledges. They sent the Laplanders further on snow shoes. These advanced 230 kilometers eastward over a continual snow desert to a height of 7,000 feet. The conditions for a snow-free interior consequently did not exist here; but this expedition, during which men have reached for the first time the interior of Greenland, has given important results as to the nature of the interior of an ice-covered continent. Over the whole inland there is ice. There occur masses of fine dust, partly of cosmical origin, with the ice. The rest of the expedition, under the command of Dr. Nathorst, visited the northwestern coast between Waigattiel (?) and Cape York. The Esquimaux told our Esquimau interpreter (Hans Christian, formerly of Capt. Hall's expedition) that two members of the American Polar Expedition had died, and the rest had returned to Littleton Island (Sofia). On August 16, the expedition sailed from Egedesmunde for the south with rich collections, zoological, botanical, and geological. Short stays were made at Iviktit, Julianshaab, and Frederiksdal. We tried to proceed eastward thrice through the sounds north of Cape Farewell and once along the coast, but were hindered by ice. We then went outside the ice-field to 60° latitude, remaining constantly in sight of land, having twice in vain tried to find an ice-free shore more to the south. The band of drift ice was forced south of Cape Dan. On Sept. 4 we anchored in a fjord which had been newly visited by Esquimaux, and where we found some remains from the Norse period. It was the first time since the fifteenth century that a vessel had succeeded in anchoring on the east coast of Greenland south of the Polar Circle. We tried in vain to anchor in another fjord more to the north, and returned. The expedition arrived at Reikiavik (Iceland) on September 9. Our observations on the temperature of the sea prove that the cold current which packs the ice along the east coast of Greenland is very insignificant; that the glaciers of the east coast are few and of no great size; and that the fjords are free from ice. Probably the coast may be reached by suitable steamers in the autumn of most years."

It will thus be seen, says *Nature*, that for once Baron Nordenskjold has failed to fulfill his predictions. But his expedition must be regarded as in all respects successful. He has succeeded in penetrating into the very heart of Greenland, and the idea of taking Lapps with him to skate their way over the rough ice-bound land was a happy one. Greenland thus appears to be what has always been conjectured, a land everywhere covered with a thick ice-sheet. We cannot gather from the telegram whether Nordenskjold's theory as to the position of the old Norse settlements has been confirmed, but he has, at all events, succeeded in bringing back remains of the old colonies. The analysis of the cosmical dust which has been collected will be eagerly looked for, and the detailed account of the collections made in Northern Greenland.

Prior to sailing, Baron Nordenskjold drew up a programme of this expedition, which was given in *Nature*, May 10, 1883.

From it we make the following abstracts:

[The following programme, drawn up by Baron Nordenskjold for his expedition to Greenland, has been kindly placed at our disposal by Mr. Oscar Dickson, who, with his well known enlightened liberality, provides all the expenses. The programme has not hitherto been made public, even in Sweden, as Baron Nordenskjold did not wish to be interrupted in his preparations with correspondence on his plans and theories. The expedition leaves Sweden in the Sofia on the 20th of May, 1883, and will call at Thurso, where Baron Nordenskjold will join the vessel.]

Nine centuries have elapsed since the Norwegian, Erik Röde, discovered Greenland, and founded Scandinavian colonies; from these, Norwegian navigators some ten years after sailed south to "Vinland," the fecundus, *i. e.*, to the shores of the present Canada and the United States, thereby acquiring the honor for the Norse race of being the real discoverers of the New World. It is not known whether these voyages led to any fixed settlements being established in America, but we know, on the other hand, from a number of Icelandic sources, that the colonies in Greenland became very flourishing. There were upward of three hundred farms, "Gaarde," of which about two hundred, embracing twelve parishes, were situated in the "Osterbygd," and about one hundred, embracing three or four parishes, were situated in the "Vesterbygd." During four centuries the country formed a bishopric, from which funds toward the Holy Wars were even contributed. Unfortunately, the connection between the colonies and the mother country ceased after a couple of centuries, while Greenland's ancient Norse population was extirpated, either through plagues or by "Skrællings," *i. e.*, the Esquimaux who descended from the North. Another explanation of their disappearance is that they lose their nationality, and were absorbed into the Esquimau population, during their contact with the more numerous tribes of the Polar regions, whose mode of living was more suited to the climate of the country and the resources at their disposal. However that may be, there remains the fact that one of the most distinct and enterprising peoples in the world have been annihilated, or, perhaps, absorbed in one distinguised as among the lowest, both physically and intellectually. The old country, belonging to the Norwegian crown, was even so far forgotten that it was only Columbus' discovery in the South which recalled the attention of the Norsemen to the fact that they had once colonized a part of this world, which was being parceled out among the southern nations by "bulls" from Rome, as if it had just been discovered.

By the aid of traditions and old journals of navigation several attempts were made to reach the old, forgotten colonies from Iceland, but these were frustrated by the enormous masses of drift ice, which then seemed to inclose the shores of Greenland's east coast more than formerly. Eventually, John Davis, in his attempts to find the Northwest passage, discovered that the west coast was easily reached, and that the seas around it offered a fine hunting ground for the profitable whale fisheries. This, with the reported discovery of gold in the country, resulted in the dispatch of several Danish hunting and commercial expeditions, which did not, however, meet with much success until the Norwegian, Hans Egede, by his zeal for bringing the blessings of the Gospel to the descendants of the old Norse colonists, caused trading and missionary stations to be established on the west coast. These were subsequently considerably augmented and extended, and henceforth held by the Danish crown, under "The Commercial Association of Greenland."

Greenland was thus inhabited by Norsemen from 983 until the 15th century, and its west coast has, during the last hundred and sixty years, been a place of sojourn for many able Danish administrators and missionaries. Beside this, nearly all expeditions which have been bound for the American Polar sea have staid here more or less, while the west coast has on many occasions been the object of carefully prepared expeditions of research. This part of Greenland is, therefore, scientifically and ethnographically one of the best known of the Arctic lands. But in spite of this we encounter here several of those *lacunæ* in the knowledge of the globe which it is of great importance that we should fill up, and some of these it is now my intention to deal with.

The east coast of Greenland was visited in 1822 by the Englishman, Scoresby, Jr., and in 1823 by Sabine and Clavering, in 1829–30 by the Dane, W. A. Graah, as well as by the second German expedition under Koldewey in 1868–69, and also by some whalers. It is, however, in its greatest extent wholly unknown, a circumstance which must be detrimental to the proper understanding of the history of first Norse colonization of Greenland, and of early voyages of conquest and discovery therefrom to the shores of America. Thus, until the east coast of Greenland is fully explored, one must continue to doubt the very forced explanation of the site of these colonies which is now predominant in the world of science. And it is, on the other hand, not worthy of the geographical discoveries of the 19th century, that a coast line extending south to the latitude of Stockholm should be so utterly a *terra incognita*.

The interior of Greenland is even less known than the east coast, and here we encounter a purely scientific problem, whose great importance is apparent from the circumstance that the unestablished theory that the interior of the island is one continuous mass of ice forms one of the corner stones in glacial science, which again is closely connected with several of the fundamental principles of modern geology. If we except a trip on the inland ice of Greenland in 1751, in lat. 62° 81' by the Danish merchant, Lars Dalager, who penetrated nearly thirteen kilometers across a comparatively even plateau, and the unsuccessful attempt by Whymper in 1867, in lat. 69° 30', where no progress was possible, in consequence of the difficult nature of the ground, only two serious attempts have been made to explore the interior of Greenland. The first of these was made by Dr. Berggren and myself between July 19 and 26, 1870, in lat. 68° 30'. Favored by the most magnificent weather, we were able to penetrate nearly fifty kilometers across a country at the outset very difficult and rent by bottomless abysses, but which gradually improved in condition the further we advanced. We had on starting the company of two Esquimaux, but they left us after two days' journey. As these who claimed to know the coast glaciers of Greenland had advised me not to waste time and labor on such a hopeless undertaking as that of penetrating over the inland ice, my outfit was very incomplete; we were in want of ropes, tent, suitable sledges, and on the Esquimaux leaving us we could not even carry the utensils necessary for cooking. I could not therefore on that occasion get very far, but I certainly came to the conclusion, that I should have been able, with a couple of smart sailors or Arctic hunters and a suitable outfit, easily to have extended my wanderings to 300 or perhaps 300 kilometers. I may also mention here that in the month of June, 1873, I effected with Capt. Palander and nine sailors a journey of more than 190 kilometers over the inland ice of Spitzbergen, which journey was of special interest to me from the circumstance that I here learned to know the character of inland ice before thaw sets in, as well as the difficulties which are at such a time attendant on journeys on the glaciers of the Polar regions. This experience, I believe, will be of great use to me during the journey now in course of preparation, as I shall have to cross portions of the inland ice which, on account of the altitude, will still be covered with snow at the time of my visit.

The second journey of research on the inland ice of Greenland was made between July 14 and August 4, 1878, in lat. 62°40', by the Danes, J. D. Jensen and A. Kornerup. This expedition was carefully equipped, but the country being much fissured, and the weather unfavorable, it did not reach much further inland than the Swedish of 1870.

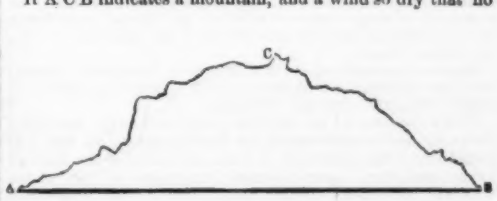
None of these expeditions saw any limit to the ice desert from their farthest point, but to infer from this that ice covers the whole interior of Greenland appears to me to be entirely unjustifiable. On the contrary, the following reflections seem to demonstrate that it is a *physical impossibility* that the whole of the interior of this extensive continent can be covered with ice, under the climatic conditions which exist on the globe south of the 80th degree of latitude.

The ice masses of the glaciers are commonly termed "permanent," a denomination which was once taken so literally that certain *savants* asserted that the ice in course of time was transformed into mineral crystals, such as those which are so frequently found in the clefts of the Alps. We know now that this term is entirely erroneous. The glacier which seems century after century to fill the same valley is not only in constant, although imperceptible, motion, by the ice masses which slowly advance from higher to lower elevations, but is also subjected to a change in its form by the circumstance that the lower stratum melts away through contact with the mountain on which it rests; while the surface on one side wastes away by thawing in the warm season and evaporation in the cold, and on the other is added to by falling snow, which latter after a time changes from snow dust to granular snow, then to crystals of ice, and eventually to a compact, homogeneous mass of ice. And, if the advancing glacier is "fed" by enormous ice-fields, or what I may term "ice-lakes," situated so high that snow always falls there copiously, it can penetrate far below the border of the perpetual snow, yea, even to parts where the snow-fall is far from sufficient to make up for the loss of melting and evaporation. It is therefore clear, that glaciers, or other constant ice masses, cannot form in places where they cannot be "fed" by descending ice, or where the snow-fall is less than the quantity which appears and disappears yearly; a circumstance which, among others, explains why no glaciers exist in the vicinity of the north Polar coasts of the new or old world.

With regard to Greenland it is not difficult to demonstrate that the above-described conditions for the formation of glaciers do not exist there, if the country does not rise gradually both from the eastern and the western shore to the center, and thus be like a loaf of bread in shape, and with sides slowly and symmetrically terminating in the ocean. Such a land formation is, however, not found in any part of the orography of the known world, and one may therefore safely conclude that neither is it to be found in Greenland. In fact, the geological nature of Greenland, very similar to that of Scandinavia, seems to indicate a similar orographical formation, viz., a formation formed of mountainous ridges alternating with deep valleys and plains; while one may even assume that the culminating line of the land in Greenland runs, as in England and Sweden, and in both American continents, along the west coast.

The winds, therefore, which should produce snow in the interior, must, if coming from the Atlantic, have in the first instance crossed the broad ice-belt generally encircling the east coast of Greenland, and then the mountains on the coast, some of which we know are very high, and, if coming from Davis Sound, the mountain ridge itself. In both cases the wind would assume the character of the "Fohn" wind, *i. e.*, it must, after passing the mountain chains on the coasts, be *dry and comparatively warm.* The law of the "Fohn" is, as is generally known, dependent on the circumstances explained below.

If A C B indicates a mountain, and a wind so dry that no



deposit of moisture takes place on the top passes from A C to B, the air will certainly be chilled in passing C, in consequence of the lower barometric pressure and consequent expansion of the air; but the same cause which produces the lowering of temperature when the wind ascends has also the effect of liberating its heat, and the air will become warmer as it descends from C to B. The compression and rise of temperature are in the latter case precisely analogous to the expansion and fall of temperature in the former; and the dry air in passing the mountain, has, therefore, on

reaching B, not suffered any change whatever in temperature or quantity of moisture. Quite different will, however, be the result if the air ascending at A is saturated with moisture, as, for instance, air passing a great expanse of water. In that case the air will expand and become colder, just as it ascends from the water surface to the mountain top, but, at the same time, part of the moisture will be condensed on the top, whereby the latent heat of the hydrogen will be set free and a rise of temperature take place, and this will, to a certain extent, minimize the fall of temperature caused by the expansion of the air. The air will retain the heat thus set free, even after it has reached, in a dry state, the point B, and the air, originally moist, has, when it has passed the mountain, attained a higher degree of heat but less moisture than at the moment of ascending. *It is in fact dry and warm.*

These causes are not only the reason of the dry warm "Fohn" winds in Switzerland, and the very remarkable circumstance that it is under winds from the snow-covered mountains that the snow disappears in Swedish Lapland, but they play also an important part in the climatic conditions of the whole globe. They are, for example, the cause of the difference in climate and flora of the two sides of the Andes, of the east and west coasts of Tierra del Fuega, and the eastern and western parts of Australia. They are the chief cause of the deserts which cover the interiors of Asia, Australia, the northern portion of Africa, and certain parts of America, while in Sweden they produce the constant western winds, and the consequent prolonged drought which invariably occurs in spring time in the central part of the country. The same laws of the temperature and moisture of the air must also prevail in Greenland. Here too the ocean winds must be moist, and this moisture is usually deposited in the form of snow on the mountains along the coast, whereas all those reaching the interior, whether from east, west, north, or south, must—if the orographical construction of the country is not entirely different from that of others on the globe—be dry and comparatively warm. And in consequence of this circumstance, the snow-falls in the interior of Greenland cannot be sufficient for maintaining a "perpetual" inland ice.

It cannot, however, be asserted that the country should here form a deserted, treeless tundra; one encounters in Siberia forests with giant trees under climatic conditions far more severe than those we may assume are to be found in the interior of Greenland. That the country should prove true to its name has besides been asserted by the celebrated botanist Hooker, from his studies of the flora of Greenland, and even the natives on the west coast themselves have a suspicion that such is the case, from the large herds of reindeer which from time to time are seen to migrate across the inland ice to the west coast.

It is most probable that the interior, if free from ice, is like a North European high plateau, with a flora far more copious than that of the coast.

But this I maintain, that whether the interior of Greenland is richly covered with forests, as the land round the frigid pole of Siberia, or is a treeless, ice-free tundra, or even a desert of perpetual ice, the solution of the problem of its real nature is so important, and of such consequence to science, that there could hardly, at the present moment, be conceived an object more worthy of an Arctic expedition than to ascertain the true conditions of the interior of this particular country.

Besides the object of penetrating to the interior of Greenland, the expedition will have several others in view, of which I may mention the principal.

To fix the limit of the drift-ice between Iceland and Cape Farewell, and to take soundings and dredgings in the adjacent seas; the collection of fresh specimens of the flora of the ice and snow; new systematic researches of the strata which in Greenland contain fossil plants; the collection of new data connected with the fall of cosmic dust.

It is clearly demonstrated by the discovery of cobalt containing iron particles in fresh snow in Europe, and the carbon-dust, also containing cobalt iron, which is found on the ice fields north of Spitzbergen, as well as by the appearance of metallic iron in "krykonit," a remarkable dust which I brought home from the Greenland ice, that the fall of a small quantity of cosmic dust always takes place, regularly or periodically, most probably in every part of the globe. But that there is a greater variation in the nature of this fall than is generally assumed, is clearly indicated by the discoveries which were made in the Vega expedition, viz., of tiny yellow crystals in the snow on an ice plateau near the Taimur peninsula. This certainly necessitates fresh researches into this phenomenon, in order to settle questions of great moment to geology and cosmology. It is very difficult to investigate this feature of cosmology, in consequence of the small quantities of dust which fall and when it takes place in closely populated districts, covered by dwellings and factories, and where the ground is perhaps only clad in snow during a short period of the season. The Polar countries, on the other hand, are particularly suited for researches of this kind, both in consequence of the purity of the air and the absence of terrestrial dust, and by the ease with which the dark dust particles are noticed on pure snow. The coming expedition will, while steaming along the ice-belts between Iceland and Greenland, and during my wanderings on the ice, be able to direct a great deal of attention to these captivating problems.

Should the conditions of the ice in Baffin's Bay be favorable, and the vessel, when in the vicinity of Disco Island, have sufficient coals for a journey northward, or should it be possible to obtain a sufficient supply from the beds found in these parts, it would be highly desirable that the members remaining on board while I am away on the inland ice make an excursion along the west coast as far as Cape York.

There are, according to statements made to the Arctic explorers Ross and Sabine, lying here on a mountain, Savilik, i. e., the iron mountain, lat. 76° 10', a couple of large, round, solitary iron blocks, from which the natives obtain the little supply of iron which they require for hunting implements and domestic utensils. The metallic constituents of these blocks are, according to an analysis made of one of these utensils brought home, iron and a small percentage of nickel, and, to judge from the descriptions by the Esquimaux, these blocks are of the same nature as those which I discovered in 1870 at Ovifak, on Disco Island. It is very strange that the remarkable descriptions by Ross and Sabine should not have been the object of investigation by the many Arctic explorers who have passed this spot. An opportunity is now at hand to ascertain the much disputed nature and origin of these iron blocks, while a few days' sojourn on this part of the coast, which is so little known, ought to be of considerable scientific value, especially as the geological features here are similar to those on Disco Island—strata bearing fossil plants.

[THE GARDEN.]

THE SOPHORAS.

THE genus Sophora, although embracing comparatively few species—about twenty-two, according to the "Genera Plantarum"—is widely distributed throughout the tropical and temperate countries of both hemispheres. Few are, however, in cultivation, and, with the exception of S. japonica and its varieties, S. angustifolia, and perhaps a Chinese species (S. kronei, of Hance) not yet introduced, probably none are quite hardy in this country. Several will succeed in very sheltered situations in favored localities, and against walls in many spots with but little care as regards shelter in severe weather; some of these are highly ornamental and thoroughly deserving attention. The best known member of the genus is undoubtedly

Sophora japonica,* one of the most handsome and distinct of hardy deciduous trees. In most localities the Sophora is a quick-growing tree, admirably adapted for the landscape in parks and pleasure grounds, and also for avenues and public squares. The feathery foliage is retained even in the driest of seasons longer than that of most of the pinnate-leaved Leguminosæ; and long after the locust (Robinia pseudacacia) has shed most of its leaves, either by reason of drought or otherwise, those of the Sophora continue to clothe the tree with a mantle of intense green. Apart from the graceful habit and the beauty of the bark and foliage, which alone are amply sufficient to recommend it for much more extensive cultivation than it can at present boast, the large, loosely branching panicles of creamy white pea-shaped flowers render it at this time of year by far the most conspicuous of outdoor trees. In well-drained, rich ground it grows with remarkable vigor and soon attains considerable size; under such circumstances seedlings will reach a height of a dozen feet or more in four or five years. That it is by no means very partial in its requirements in this direction is proved by the fact that it thrives perfectly on the dry, sandy, gravelly soil at Kew, where there are several fine specimens of different ages and sizes, which are now one mass of bloom. Seeds are never produced at Kew, and, indeed, probably nowhere in Britain; in Central and Southern France, and elsewhere on the Continent, they are ripened annually.

The hardiness of Sophora in this country is now established in spite of Loudon's assertion that "north of London they are rather tender." In Colonel H. M. Drummond Hay's pamphlet (1882), "The Comparative Hardihood of Hard-wooded Plants from Observations made at Seggieden, Perthshire, during the Winters of 1878-79, 1879-80, 1880-81," Sophora japonica is spoken of as being perfectly hardy. It may be as well to call the attention of tree lovers to this pamphlet, as it contains, in a concise form, a good deal of valuable information; all the trees and shrubs grown by the author are arranged in four sections, according to their relative degrees of hardiness. Section No. 1, in which Sophora japonica is placed, contains "those which have passed scathless through the severest winters and coldest springs, and therefore may be considered as truly hardy."

History.—The first trees of S. japonica were raised in Europe in 1747 from seeds sent from China by Father D'Incarville to Bernard de Jussieu. These seeds were sown in the garden of Louis XV. at Trianon, but it was about a quarter of a century later before any of the plants raised had ripened fruits. The first record of the Sophora in England is in 1753, some half-dozen years after its introduction into France. It was then grown in the celebrated nursery at Mile End by Gordon, to whose skill in the propagation and cultivation of new and rare plants Collinson, the friend and correspondent of Linnæus, pays a grateful and graceful tribute. It was probably at the suggestion of Collinson that Linnæus formed his genus Gordonia to perpetuate Gordon's name.

Large Specimens—I am indebted to Mr. J. Smith, the ex-curator of the Royal Gardens, Kew, for information respecting the early history of the large specimens at Kew, detailed measurements of which are given below. It appears that five plants were at an early date procured for Kew (two of these no longer exist), and, under the impression that the species was tender, all, with one exception, were planted against walls. There is a fine tree between the new rockery and the new range; a circular seat surrounds the trunk. It grew in the angle of the meeting of two walls, and in Mr. Smith's day the trunk pressed against them. With regard to the specimen in chains, it flowers abundantly, and when the flowers fall they whiten the ground, and are then much frequented by bees; you cannot even walk without treading on them. It thus appears that the bees cannot get at the honey until the flowers fall. This may account for the tree not producing seed-pods, the flower not being in a state for the bees to enter to disturb the pollen. A third specimen is still growing in the village of Kew against the house formerly occupied by Mr. Aiton, the first director of the Royal Gardens. Loudon states that the finest tree in the neighborhood of London was at Syon; he gives its dimensions as 57 feet in height, diameter of trunk 3 feet, and of the head 80 feet. Mr. Woodbridge has furnished me with the present measurements of the largest tree now at Syon—in all probability this is the tree mentioned by Loudon—height 70 feet, circumference of trunk at 2½ feet from the ground 12 feet, and spread of branches 70 feet. The Kew specimen stated by Loudon to be 50 feet high is probably the one on the lawn. This specimen, at a few feet from the ground, divides into several branches of considerable size, some of which are now supported by strong chains. It forms a very picturesque object, and has been frequently sketched by artists and photographed. The height at the present time is 50 feet, circumference of trunk at 1 foot from the ground 13 feet 6 inches, and spread of branches 65 feet; the circumference of largest branch is 6 feet. The tree near the rock garden has a trunk 11 feet 6 inches in circumference at 1 foot from the ground, and a spreading head 50 feet in diameter; the height of this was not taken, but it is between 40 feet and 50 feet. The tallest Sophora at Kew is near the Richmond end of the Holly Walk; tape-line measurements make this 75 feet high with a trunk of 7½ feet in circumference at 3 feet from the ground; no branches are given off below 30 feet from the ground, where the trunk measures 6 feet in circumference.

Var. pendula.—This is one of the most remarkable and beautiful of all weeping trees. Even when deprived of its

Branchlets of Sophora japonica pendula.

Branchlet of Sophora japonica.

Flowers of Sophora japonica.

Sophora macrocarpa.

Sophora microphylla.

Sophora tetraptera.

* IDENTIFICATION—Sophora japonica, L., "Nouveau Duhamel," iii., t. 21; Loudon; "Arboretum et Fruticetum Britannicum," ii., p. 563, etc.; Koch, "Dendrologie," theil 1, p. 13; Styphnolobium japonicum, Schott in Wien, Zeitschr. iii., 844.

leaves, the bright, smooth green branches render it truly ornamental. Loudon speaks of this variety as follows: "The pendulous variety is well deserving of culture as an object of singularity and beauty; and where it is desired to cover a surface with intense green foliage during summer—for example, a dry hillock—a plant of this variety placed on the center will accomplish the purpose effectually. When grafted on the common form at a height of 8 feet or 10 feet or more, the branches fall gracefully on all sides of the stock, and form what one might designate as a leafy cascade of darkest green. I have been unable to trace the history or origin of this variety. Considering its peculiar aspect and good qualities, perfect hardiness and vigorous growth, it seems strange so charming a tree should not be more frequently planted."

Var. variegata.—Except to collectors, this form is next to useless. The variegation is by no means striking, being a dull yellowish white, generally at the margin of the leaves, It is, moreover, not so robust as the type or the weeping form above mentioned.

Two other names are given in M. Lavallée's "Arboretum Segrezianum," viz., violaceum and pubescens. The former of these I have not seen, but what I have noticed under the latter name do not seem to differ in the least from typical Sophora japonica, different seedlings which will exhibit various degrees of hairiness. With regard to this so-called variety, Koch makes a similar statement in his "Dendrologie."

Medicinal Properties.—The dried flower buds furnish a drug which finds a place in the Chinese *materia medica*. Their principal use, however, appears to be that of a dyeing material, being employed in preparing the fine yellow silk which is used for the garments of the mandarins; they are also used for dyeing blue cloth green. In Europe Sophora has been noticed to possess purgative properties. Nearly half a century ago M. Fleurot, of Dijon, from chemical examination concluded that the active principle is an uncrystallizable substance analogous to the cathartine of senna leaves. The same chemist also remarked that the dust of the wood inhaled by turners is found to have a purgative effect. Similar effects are, it is said, caused by the leaves and flowers. "In the botanical garden at Dijon is a well beneath a fine Sophora. When its leaves or flowers are about to fall the gardener carefully covers the well, having found by experience that the water acquires laxative properties through the Sophora being infused in it."

*Sophora angustifolia.**—I am not aware that this species is cultivated in England, but its name is included by M. Lavallée in his list of the trees and shrubs grown by him at Segrez. It differs from S. japonica in its more numerous narrower leaflets and dense racemes of smaller flowers. A native of Japan.

*Sophora secundiflora.**—This is grown at Kew in the temperate house, and in the neighborhood of Paris, as we learn from the *Revue Horticole*, it requires the shelter of an orangery during winter. It is, however, well worth growing in a tub for conservatory decoration. The handsome blue violet-scented flowers are produced at the ends of the branches. "A small tree about 30 feet in height; the wood yellow, hard, and heavy, called lignum-vitæ. . . . The three forms small groves on the shores of Matagorda Bay, where it is the only firewood. The wood dyes yellow. An exceedingly poisonous alkaloid, to which the name of sophorin has been given, is produced from the (bright coral red) seed of this species."—Prof C. S. Sargent, "Catalogue of the Forest Trees of North America," p. 16.

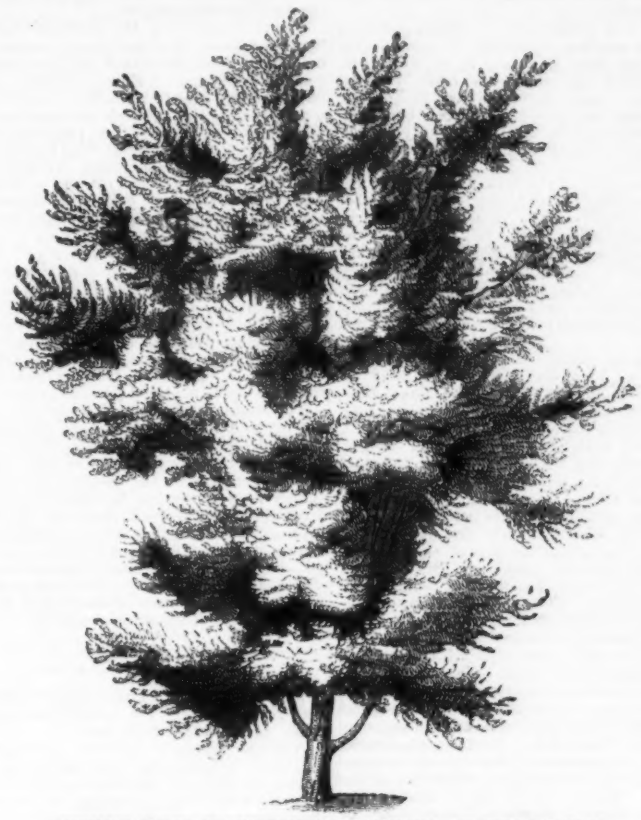
Sophora tetraptera.†—A native of New Zealand, where it forms a tree with a trunk of 1 foot to 3 feet in diameter; and also of Chili and Juan Fernandez. In England this requires the protection of a wall and even a certain amount of protection in severe weather. Its golden yellow flowers, nearly a couple of inches in length, are produced in spring. A colored plate will be found in *The Garden*, vol. xxii., p. 160, and a woodcut in vol. xxiii., p. 441. Other references to this handsome shrub are vol. xxiii., pp. 394 and 477. Sophora microphylla, Ait. (Edwardsia microphylla of Salisbury) is only a form of the preceding, with more numerous leaflets and rather smaller flowers.

*Sophora macrocarpa** was introduced by Loddiges in 1822. In Chili, where the inhabitants call it Mayu, it forms a fine tree. Lindley, in the *Botanical Register*, vol. xxi., t. 1798, gives a colored figure of the plant, which he says "proves to be a hardy, handsome tree, flowering in May in great profusion. We believe that it at present exists in no other collection." This was in 1836, and the establishment Lindley speaks of is that of Loddiges. Like the preceding species, S. macrocarpa no doubt requires the shelter of a wall in the open air in Britain.

GEO. NICHOLSON.

Royal Gardens, Kew.

SOPHORA JAPONICA PENDULA IN WINTER.



YOUNG TREE OF SOPHORA JAPONICA, 20 FEET HIGH.

SOPHORA JAPONICA PENDULA IN SUMMER.

SOPHORA JAPONICA.—FULL GROWN TREE AT SYON, 70 FEET IN HEIGHT.

* IDENTIFICATION.—Sieb. and Zucc. Fam. Nat., p. 10. So mokon Zensetz, vol. xiv., fol. 28, sub Koura ra.

* IDENTIFICATION.—Lag. in D. C. Cat. Hort. Monsp., 148; "Revue Horticole," 4, 3, 201, t. 11.

† IDENTIFICATION.—Hooker, "Flora of New Zealand," p. 52; Edwardsia grandiflora, Salisb.

* IDENTIFICATION.—Smith in Rees' Encycl.; Edwardsia chilensis, Miers' "Travels in Chili."

PERCHAS

FOREMOST amongst pseudo-guttas, as we use the phrase, stands Balata gum. It is obtained from the *Mimusops Balata* of Gærtner (Nat. Ord. *Sapotaceæ*) and is synonymous with the *Sapota Mulleri* of Bleekrod, the *Achras Balata* of Aublet etc. It is found in Demerara, Berbice, British and French Guiana, Antilles, Jamaica, and Surinam. It has many vernacular names, among which may be mentioned Balata, Pardenvleesch (Dutch—horse-flesh), bullet-tree, etc.

One of the first writers on this substance was Professor Bleekrod, who communicated some information as to the plant and its product to the Society of Arts, in 1857. He, too, described the plant and named it *Sapota Mulleri*. In 1860, Mr. Walker communicated samples, etc., received from Dr. Van Holst, of Berbice, to the same society, and

in 1864 Sir William Holmes also drew attention to the same subject. The tree is a large one with a trunk of about 6 feet in diameter, and furnishes a wood much liked for building purposes and of the color of horse-flesh—hence the Dutch name. The bark is thick and rough, and the fruit is of the size of a coffee berry, sweet like a plum, and with a hard white kernel which yields a bitter oil.

The leaves are glossy, oval, and acuminated. The milk is drunk by the natives, in cases of diarrhœa, and when diluted with water it is used as cow's milk. The trees grow in groups and in alluvial soil.

The "Balata" gum is of a character somewhat between caoutchouc and gutta percha, combining in some degree the elasticity of the one with the ductility of the other, freely softening and becoming plastic and easily moulded like gutta percha. What small parcels arrived in England met with a ready sale and were remarkably free from adulteration. But unfortunately, through the difficulty of collection—the undertaking being so dangerous and unhealthy—the supply of this excellent article has fallen off. It is collected by making incisions in the bark about seven feet from the ground, and a ring of clay placed round the tree to catch the milk as it exudes. The yield is said to be in profusion, especially at the time of the full moon, and the operation can be repeated every two months in the rainy season. It takes six hours to bring about coalescence by simple atmospheric influence, but very quickly by boiling in water. A large tree is said to yield as much as 45 pounds of "dry gum." The tree in every way is well worthy of a trial by acclimating it.

In India there are several plants whose products may be classed as pseudo-guttas. First and foremost of these we have the Pauchontee or India gutta tree, the *Bassia elliptica* of Dalzell, the *Isonandra acuminata* of Lindley, but now known as *Dichopsis elliptica*. It is found in the Wynaad, Coorg, Anamallay, and Neilgherry Hills, Sholah Forest, Cochin, Sichar, and, according to General Cullen, "appears to be common in all the forest tracts at all within the influences of the southwest rains." This tree, which is now placed in the same genus as the true gutta percha, is a large one—from 80 to 100 feet high—and was first met with by Mr. Dalzell, in North Canara, near the falls of Goirsuppah, in 1849. Since that date General Cullen and Dr. Cleghorn have used every exertion to bring the substance prominently forward, but without success. The gum is obtained by tapping, 1¼ pounds being obtained frum one tree by five or six incisions, a large tree yielding as much as 20 to 40 pounds of sap. Many experiments have been made with specimens of the raw milk, *i. e.*, milk simply dried by exposure to the atmosphere. The results of these experiments have shown that for telegraphic purposes it is wanting in some essential qualities, but it has been recommended as a subaqueous cement or glue. When dissolved in ordinary gutta percha solvents, it, after the evaporation of the solvent, remains sometimes soft and viscid, and partakes somewhat of the character of bird lime. When cold, it is hard and brittle. Without wishing in the slightest degree to throw doubt or discredit on the many and valuable experiments made, we would suggest that good samples be collected and treated in the same manner as recommended for gutta percha. We have no doubt that many a parcel of what would otherwise be *good* gutta percha, is spoiled through not being well boiled *immediately* after collection from the tree. At present this is the only way in which we see there is a possibility of ascertaining whether this product can be utilized, and we have the more hope from the fact that the structural character has led the plant to be placed in the same genus as the true gutta percha—structural affinity agreeing so often to chemical affinity.

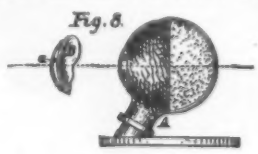
There are in India other nearly allied *Sapotaceæ* which deserve attention in order to ascertain whether any of them yield a milky juice likely to be of commercial use. Among the *Euphorbiaceæ* there are two plants worthy of notice. The *Euphorbia Cattimandoo*, found in various parts of India, was first brought to notice by the Honorable W. Elliot, and a prize medal was awarded for this substance by the jurors of the 1851 exhibition. The spiny euphorb grows to the size of a shrub or small tree, and the milk flows out freely when a branch is cut. The natives use it as a cement to fasten knives in handles, etc. Under the influence of heat it becomes soft and viscid, and when dry, very brittle. The *Euphorbia Tirucalli*, the milk bedge or Indian tree spurge, is a succulent unarmed plant attaining a height of twenty feet, and its inspissated milk is used for various—chiefly medicinal—purposes, and has been recommended as a gutta percha substitute, but, like gum *Euphorbium*, it has a very acrid character, and the collection is a very dangerous operation to the eyes.—*Indian Agriculturist.*

Continued from SUPPLEMENT, No. 408, page 6513.

THE EYE AS AN AID IN PHOTOMETRY.

THE effect of such a lens as the eye may be studied by means of a small globular flask filled with water. The flask may have an imitation of the cornea secured upon its surface with cement, a small air hole being left at the point of junction, by means of which the space, *a*, Fig. 8, B, can be filled

Fig. 8.



by exhausting an air pump receiver in which the flask is placed, submerged in water, or a spot about the size of a shilling may be heated near the neck of a flask, and upon blowing into the flask the surface of the spot can be forced outward to the desired form. The opposite hemisphere of the flask should then be ground, and the rest of its surface, between the ground part and the artificial cornea, painted black. The flask when filled with water will be found to form upon the ground surface a picture of the objects toward which the imitation cornea is directed, provided of course that the surface representing the cornea has the proper radius struck from a center at suitable distance from the center of the flask. A, Fig. 8, represents such a lens, secured to a stand.

It may then be asked, What is the use for variously shaped lenses? The answer to this is twofold. First, to correct chromatic aberration; next, to provide means for keeping the focal length constant, whether looking at near or at distant objects, in order that in both cases the rays refracted at the surface of the cornea may be focused on the retina. It has been calculated by Olbers that without this accommodation the difference in focal length for objects as near as 4 inches from the eye, and so far away that the rays might be considered parallel, would be only 0·143 of an inch, and as the whole retina is only from 0·00625 to 0·0125 thick, while the length of the rods and cones which are influenced by light is only one-sixth of that, or at most 0·0021 of an inch, it will be seen that this ability to accommodate the eye to both near and distant objects is very important. It is very wonderful that the eye itself is so formed that the limit of variation in focal length should be so small as 0·143 of an inch and that at the same time it should contain within itself this power of accommodation.

Means of correcting the chromatic aberration are needed, because without them the rays of various color would not be coincident upon the retina, and the images of objects there formed would have a blurred outline. Light rays of different colors are bent or refracted to a different extent. When a ray of white light, which is a combination of the various colored rays of the spectrum, passes into a medium of different density to that through which it has been passing, the rays of different colors being refracted to different extents take different paths; and the ray of white light is decomposed into its various colored constituents, which become visible at different parts of the screen on which the ray falls. This phenomenon is termed chromatic aberration. Now the material of the eye itself is not only of low refractive power as compared with glass or the diamond, and consequently does not disperse the colored rays to so great an extent, but the dispersion, or as it is termed deviation, that does occur is corrected by the combination of lenses formed of materials having different refractive powers. The rays do not deviate far through one medium; a different medium with surfaces of different curvatures collects them again; and thus the eye is rendered practically achromatic.

The angular difference of deviation between the brightest red ray and the brightest violet ray transmitted by a prism is called the dispersion of the prism. If μ represent the index of refraction for the brightest part of the spectrum when a prism is in the position of minimum deviation—which is the position in which the rays are less refracted from the original path than any other—and if μ_r and μ_v represent the indices of the two colored rays under consideration; then the deviations would be $(\mu - 1)\, l$, $(\mu_r - 1)\, l$, and $(\mu_v - 1)\, l$. The difference of deviation between the red aad violet rays would be $(\mu_v - 1)\, l - (\mu_r - 1)\, l = (\mu_v - \mu_r)\, l$; and the ratio between that difference and the deviation for the brightest part of spectrum would be:

$$\frac{(\mu_v - \mu_r)\, l}{(\mu_v - 1)\, l} = \frac{\mu_v - \mu_r}{\mu - 1}$$

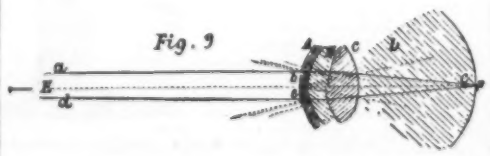
This is called the dispersive power of the substance of which the prism is made. The value of this ratio is 0·033 for crown glass, and 0·052 for flint glass.

Newton supposed this ratio the same for all substances, and that achromatism was impossible. It was, however, shown by Hall, and afterward by Dollond, that this opinion was erroneous; and advantage is taken of this difference of dispersive power to construct lenses for optical instruments. Achromatic lenses usually cousist of a diverging meniscus of flint glass, and a double convex lens of crown glass, fitted one into the other. The so-called achromatic eyepieces of microscopes and telescopes, however, are made of two lenses of crown glass, having different curvatures, and so arranged that the one corrects the spherical and achromatic aberration of the other, not by making the red and violet images coincide, but by causing one to cover the other at the point where the eye perceives the image. The compound lens of the eye has however already been shown to be of more complex structure.

To provide an optical instrument with means for accommodation to different distances, the optician would either vary the distance between the surface at which the rays were refracted and the screen on which they were focused, or he would provide lenses of varying convexity, or of materials having different refractive indexes. Helmholtz, who studied this subject very fully, constructed an ophthalmeter with which he could measure alterations in the relative positions of the images reflected from the surfaces of the various lenticular media of the eye. These measurements gave data for calculations, and it is ascertained that there is a change in the shape of the crystalline lens. During accommodation to near objects, the curvature of the cornea and of the posterior surface of the crystalline lens remains unaltered, but the anterior surface of the lens becomes more convex, and approaches the cornea. There is but little doubt that the power by which this change is effected is supplied by the ciliary muscle, which arises at the inner surface of the sclerotic, close outside the margin of the cornea, the muscular fibers passing to the ciliary processes, in which they are inserted. There are also some circular fibers. When excited it draws forward the choroid, and thus the tension of the suspensory ligament is lessened, and the anterior surface of the lens, in virtue of the elasticity inherent to the lens, assumes a more convex form, it being kept in tension when the eye is at rest. The ligament is attached to the margin of the anterior surface, and when in tension, pulls it to a flatter form without altering the posterior surface.

In every eye there is a limit to the power of accommodation. If two pinholes be made in a card, one-tenth of an inch apart, and a small needle be viewed through the holes, one eye being closed, and the card held close to the other, the needle can be clearly focused up to a moderate distance. Nearer than 6 inches or 8 inches two images are seen, or the image is ill defined. The point at which this occurs is called the near point. Fig. 9 shows the alteration in the form and

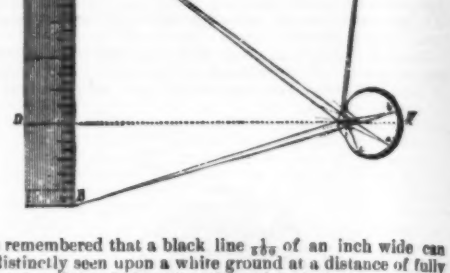
Fig. 9



position of front face of the crystalline lens that takes place on adjustment for long and short distances. Above the line, E F, the lens is shown adjusted for distant objects, and the ray, *a b*, is focused at *c*. A ray, *d e*, from the center of an object at about 4 inches distance is shown below line, E F, and is also focused at *e*. Rays coming from a point lying at an angle with the line of vision, taking that line to be a prolongation of the line, E F, are focused on the retina at a point in a plane containing also the line, E F, and the point from which the ray comes. The rays are focused on the retina on the opposite side of the line, E F, to that on which lies the point from which the rays proceed. In Fig. 10 the eye is represented looking at the edge of a rule held horizontally before it at a distance of 4 inches; two rays are shown coming from A; and, passing through the pupil at its opposite sides, they are focused at *a*. Similarly two rays from B are focused at *b*. In this way an image of the edge of the rule is formed along the retina from *a* to *b*. Two rays are also shown coming in the direction, C, from a point on a line at an angle of 95 deg. with the axis, D E, of the eye, and they are focused at *c*, near the margin of the retina.

If the rule were at a greater distance, the image on the retina would be correspondingly shorter. When, therefore,

Fig 10.



it is remembered that a black line $\frac{1}{500}$ of an inch wide can be distinctly seen upon a white ground at a distance of fully 3 feet, it will be obvious that the width of the image of that line upon the retina cannot be more than $\frac{1}{2500}$ of an inch wide. It is said that brilliantly illuminated specks of gold dust of half that diameter can be distinctly seen. How delicate then must be the minute organs which are stimulated to send intelligence to the brain of the presence of such tiny images! The eye cannot, however, distinguish between two such minute objects if their images on the retina lie closer than $\frac{1}{2500}$ of an inch, and that is found, by microscopical measurement, to be the diameter of the cones in the central part of the retina. Hence, although there is consciousness of an image which covers but $\frac{1}{10}$ the area of a cone, unless two such images lie upon different cones, the eye does not distinguish between them. The rods and cones are shown at H, Fig. 11, which is a diagrammatical representation of a

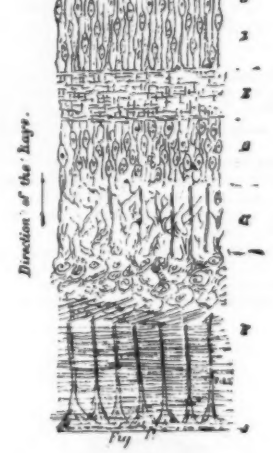


Fig. 11.

section of the retina. A is a very delicate membrane next the vitreous humor; B, a layer of nerve fibers radiating from the optic nerve, with an outer layer of ganglion cells, lying in the spaces of a connective tissue framework. C is a layer of connective tissue, traversed by very fine fibers from the ganglion cells; D, a layer of small round nerve cells embedded in connective tissue; E, a layer of connective tissue traversed by nerve fibrils; F, several strata of small nerve cells connected by fibrils with the rods and cones. G is a membrane which defines the internal limit of the rods and cones, and H the rods and cones; I, the pigment cells of the choroid coat in which the ends of the rods and cones are embedded.

At the central portion of the retina, all the layers are much reduced in thickness, except that of the rods and cones, which is much thicker than elsewhere. The depression thus formed is of a yellow hue, and is called the yellow spot. The cones here are very close together and smaller in diameter, as well as much longer than in other parts of the retina. This, too, is the most sensitive portion of the retina. Beyond the margin of the yellow spot there are spaces between the cones, and these spaces are filled up with rods surrounding each cone. In the outer part of the retina the cones are much fewer in number than near the yellow spot. In the rod and cone layer of the retinas of birds there are usually many more cones than rods. In man the reverse is the case. In nocturnal birds, however, as the owl, and in many nocturnal and burrowing animals, as the mole, mouse, and bat, only rods are present. Fibers from the rods and cones pass through the connective tissue to the ganglion cells, and these in turn are connected with the optic nerve.

It is not, however, at the rods and cones that the individual is conscious of light, but at the brain; for where the eye has been destroyed by accident or disease, the sensation of light may be produced by pinching or otherwise exciting the optic nerve. Nevertheless, that it is the rods and cones which convert the light vibrations into a stimulus to be conveyed to the brain by the nerves, is proved by the fact that if in a dark room a candle be moved to and fro at the side of and close to the eye, while the eyes look steadily forward into darkness, a branching figure of dark lines on a reddish ground is seen. As the candle is moved, the figure moves in an opposite direction. This branching figure is the shadow of the retinal vessels, which have already been shown to be inside the rods and cones, cast upon the retina by the candlelight; and it is obvious that the elements of the retina

which send the knowledge of the presence of this shadow to the brain must be outside the vessels.

Moreover, just at the point where the optic nerve enters the eye is a circular space where there are no rods or cones, and from this portion of the retina there is no sensation of light. This may be proved by marking upon a card a small cross 3 inches distant from a circular spot $\frac{1}{10}$ of an inch in diameter. Hold the card about 15 inches from the eye and look steadily at the cross, the spot being toward the outer side. The spot will be plainly seen, but when the card is moved to 11 inches or 12 inches from the eye the spot is invisible, but is again seen when the card is brought to 7 inches or 8 inches from the eye. This clearly proves that while the image of the spot was traversing the point of entrance of the optic nerve, the brain was not rendered conscious of the presence of that image. This portion of the retina is called the blind spot.

The eye, therefore, may be compared to a camera, the iris acting as a diaphragm to prevent spherical aberration by obstructing the passage of all marginal rays from an object in front of the eye which it is desired to examine closely. Distinctness of vision is best obtained when abundant light falls upon the object viewed, when the object is held as near the eye as accommodation will allow and when the marginal rays are cut off by contraction of the pupil. It is further secured by the interior of the eye being coated with black pigment cells, which absorb the rays and prevent internal reflection. Achromatism is secured by a system of compound lenses varying in refractive power, while accommodation to near and distant objects is provided for by the crystalline lens being capable of alteration in form and position.

In estimating the brightness of a luminous surface which is not large enough to fill the retina, it is necessary to distinguish between effective brightness and intrinsic brightness. The latter exceeds the former in the same ratio as the area of the pupil exceeds the area of the beam passing through it. When a beam of light fills the area of the pupil, the effective brightness equals the intrinsic brightness.

Intrinsic brightness may be thus measured:

If A be the area of the pupil, and a that of a small surface directly opposite the pupil and perpendicular to the line of vision: and if d be the distance between A and a, then the quantity of light, Q, passing in unit time from a to A, varies jointly as the area, A, the apparent area of a (which, as it will vary as the square of the distance, may be expressed $\frac{a}{d^2}$), and the intrinsic brightness, I. Thus:

$$Q = A\,I\,\frac{a}{d^2} = a\,I\,\frac{A}{d^2}.$$

If ω represent the solid angle of light subtended by the pupil from the central point of the surface a, ω will vary as $\frac{A}{d^2}$; then $Q = a\,I\,\omega$, therefore $I = \frac{Q}{a\,\omega}$. This is the reason why, if no light be stopped by the air or other medium intervening between the surfaces and the eye, surfaces of equal brightness appear equally bright at all distances; for the area of the image formed on the retina varies with the square of the distance, as also does the quantity of light from each point of the surface, as already shown. Therefore, as the distance increases a larger portion of luminous surfaces is focused on the same area of the retina, in exactly the same proportion as the quantity of light from each luminous point of the surface is decreased. Hence in photometrical measurements the rays from lights to be compared are generally received upon a screen or screens; for then the eye sees simply the effect of the lights upon the screens. The images of the lights are not formed on the retina, but images of the screens, upon which by various arrangements the lights are made to give effects of apparently equal value. It is very difficult to estimate fractional differences of illumination. To discern the difference of illumination between one candle and two candles, at equal distances from a screen, is easy, but as lesser differences occur the eye is a less accurate measure, and it is hard to distinguish much difference between the illumination afforded by nine candles and by ten at equal distances from a screen. It is however said that a difference in intensity of light or shadow of only $\frac{1}{10}$ is perceived if the fields of light and shade are each uniform, and if they are very near together. It must be remembered that the question is not one of affecting more rods and cones, but of discerning the differences of the physiological effects produced upon the same number of rods and cones by nine candle light and by ten. The point is analogous to judging the difference in weights. One can readily perceive the difference between the heaviness of two articles weighing respectively 2 pounds and 4 pounds, but it would be difficult if not impossible to tell, by balancing in the hand, whether an article weighed 3·6 lb. or 4 lb.

Light rays are accompanied by heat rays and by chemical rays, and it is found that the heat rays are less refrangible than the light rays, while the chemical rays are more refrangible. Fig. 12 gives the intensity curves of light and

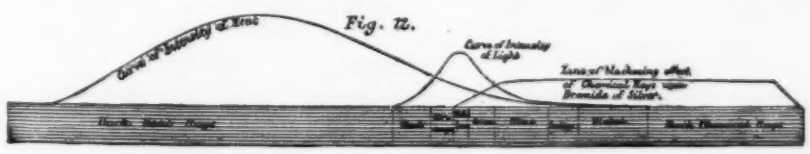


Fig. 12.

heat. The chemical rays have their maximum effect in that part of the spectrum in which the violet rays are situate, and extend beyond the visible spectrum to a distance of about two-thirds its length; all the chemical rays being more refrangible than the rays of the brightest part of the visible spectrum. The extent of their blackening power varies with different substances. The line showing the blackening effect upon bromide of silver must not be taken as an intensity curve; it simply shows the length and position of the blackened part as compared with the visible spectrum, the point of maximum effect, and the somewhat rapid shading off at both ends. Some other substances are blackened more toward the orange and more beyond the violet. The heat curve shows the extent to which the heat rays are refracted, as compared with the same visible spectrum.

It has already been noticed that colored rays being differently refracted, refraction is largely prevented in the eye. Still, the eye is not equally affected by light of all colors; and it has been ascertained that the area of the retina capable of being impressed by any particular color differs slightly for the various colors. One observer may also think an object to be of one shade of color, while another will pronounce it of a different shade, although the eyes of both are equally sensitive to color.

It is generally agreed that there are three distinct physiological actions developed in the retina, which, variously combined, give various color sensations; and that each of the three is excited to its maximum by a light of a particular wave length, and affected only to a slight degree by light of other wave lengths. One of these sensations is considered to be best excited by the green, another by the deepest red, and the third by the violet. Helmholtz suggests that different nerve fibrils go to different strata in the length of the rods and cones, and that the colored rays, being variously refracted, are focused at these different depths in the retina.

It will thus be seen that it is difficult for the eye to accurately compare the intensity of lights of different colors. Spectrophotometry is probably the best method of comparing such lights.

In conclusion, it may be observed that considering these circumstances, and that heat rays are of one series of wave lengths, the various visible rays of another series, and the chemical rays of another, the retina can hardly be sensible of many of the chemical rays or heat rays; for owing to the difference of refrangibility most of the chemical rays would be focused in front of the retina, while such of the heat rays as were not absorbed by the media of the eye would be focused beyond it. For these reasons, in comparing the illuminating effect of lights by chemical photometry, the chemical effects produced would not be a measure of the illuminating effects, unless it could be shown that both varied in the same ratios. The white light from snow is painfully brilliant to the eye, while a piece of black hot iron sends hardly any light rays to the retina, and is visible chiefly by comparison with the surface on which it lies, just as a hole is seen. Still, the black hot iron would send many more heat rays to the eye than the snow. Consequently, as intensity of heat is no measure of intensity of light, it may be doubted whether intensity of chemical effect can be.—*Engineering.*

THE SWISS NATIONAL EXHIBITION.

THE Swiss Exhibition, which is being held in Zurich this autumn, appears to be in every sense successful, and is well worth a visit from any one whose summer excursion takes them within reach of the pleasant and picturesque town in which it is being held. Those who have visited Zurich will remember that the town lies on two rivers, the Limmat (which runs out of the Lake of Zurich) and the Sihl, which joins it toward the north of the town. The handsome railway station lies just between the two rivers, a third of a mile or so from their junction, and the site of the Exhibition and its grounds is the triangle of land included between the station buildings on the south and the two rivers on the east and west. This situation, besides having much natural beauty, has an advantage in point of convenience of access which will not be underestimated by any who remember the long ride out of Dusseldorf or Brussels before their exhibitions could be reached.

The main building or "Industry Hall" of the Exhibition is a building about 575 ft. long by 190 ft. wide, made slightly enough externally, but without any pretensions to special architectural merit, not being intended to be permanent. This building contains the exhibits of all the sections except those having separate pavilions in the grounds, and those more or less directly connected with engineering. These latter are housed in a Machinery Hall, built upon the west side of the Sihl, and approached from the grounds of the Industry Hall by a couple of bridges constructed specially for the purpose. The Machinery Hall and its annexes cover more space than the main building just mentioned. The hall is in the form of an L, the one limb being 544 ft. by 150 ft., and the other 456 ft. by 165 ft., and each consisting essentially of a nave about 80 ft. wide, with aisles on each side. The whole buildings on this side of the river cover a space of about 23,600 square yards. The sections represented on this space are chemistry, raw materials, leather, constructive materials, architecture, civil engineering, transport, machinery, metallurgy, arms, agriculture, food, and hygiene.

The Zurich Exhibition, at least so far as the sections affecting engineering are concerned, is distinguished by the very high average quality of the exhibits. There are few absolute novelties, or objects that are in themselves specially striking, but, on the other hand, there is an almost entire absence of low class work or conspicuously inferior designs, such as are often so numerous at shows of this kind. We do not remember before having seen an exhibition at which this characteristic of general excellence was so striking. There are, of course, some firms, mostly well-known ones, whose work distinctly excels, both in design and quality, but they are not separated from the rest by any impassable gulf of difference, and even at the bottom of the scale are found very few exhibits which were not worthy, on their own merits, of a place in the Exhibition.

CIVIL ENGINEERING.

Switzerland being the country of all others, at least on this side of the ocean, where civil engineering work has been attended with the greatest difficulty, and where, perhaps for that very reason, the carrying out of such work has been most essential, we naturally look first at the exhibits in Group 20, *Ingenieurwesen*. The group is divided into four sections—road works, railway works, river works, and iron works—in all of which drawings, photographs, models, and descriptions give a pretty vivid idea of the difficulties of the work undertaken and the laborious way in which these difficulties have had to be overcome.

In connection with road works—which are now in Switzerland, as with us, rather matters of history than of present practice—models and drawings of some of the old covered timber bridges are very interesting, as illustrating details of engineering construction in wood in the early part of the present century and earlier. Among others the drawings of the well-known Spreuer-brucke, in Lucerne, with its arch of six thicknesses of flat timbering, and the model of the Sitter-brucke, at Bischofszell, are particularly interesting. A great contrast to these is presented by the drawings (exhibited by the contractors, Messrs. Ott and Co., of Bern) of the Schwarzwasser Viaduct, constructed by them on the Bern-Schwarzenburg road. This bridge is a light wrought iron arch (resembling the Javroz bridge built by the same contractors, but larger) of 374 ft. span, with a rise of 70 ft. The height of the road above the valley is 207 ft., and the breadth of the roadway 19·7 ft. The total length of this bridge is 548 ft.; its situation is 3150 ft. above the sea. The interest of the exhibit is considerably increased by its including drawings of the scaffolding, etc., as well as of the bridge itself. We did not see among the exhibits, by the way, any mention of a road about which so many Englishmen are interested, viz., that from Visp to St. Niklaus. No doubt there will come a time when travelers will not have to pay so heavily as at present for the small interests of the St. Nicklaus Commune!

ST. GOTHARD RAILWAY.

In the railway work section the exhibit which will naturally exite most attention is the splendid collection of plans (scale $\frac{1}{1000}$) exhibited by the Gothard Railway Company, along with photographs of the works, bridges, etc., working drawings of some of the latter, and a collection of minerals from the various tunnel works. It seems to be only now beginning to be recognized that although there is no doubt something fascinating about the big tunnel and its difficulties, yet the really most interesting part of the work lies outside the tunnel itself. The laying out of the approaches to it on both sides, and especially the daringness of the spiral tunnels and the apparent impossibility of the triply terraced railway—three levels one above the other, simultaneously visible and all to be traversed in succession by the train—are together, whether on paper or in reality, much the most impressive part of the work. It is a very odd experience to hold a compass in one's hand while passing through one of the spiral tunnels, and to watch the needle, apparently boxing the compass of its own accord, for the turning of the train is so continuous as not to be sensible.

The "Compagnie des Chemins de Fer de la Suisse Occidentale et du Simplon" sends drawings of the projected Simplon Railway from Brieg according to the most recent schemes, with sections of the whole line including the tunnel, this latter 19,795 meters, or 12·3 miles long, about half in Switzerland and half in Italy.

The *Collectiv-Ausstellung der Schweizerischen Specialbahnen* is very interesting, although of course with little application to any probable wants of our own country or colonies. A note of the leading features of the exhibiting railways may not be uninstructive; they are as follows:

SWISS RAILWAYS.

1. *Aarganische Seethalbahn* (Lucerne-Lenzburg).—A normal gauge tramway worked by locomotives, in process of construction. Its length is 42 kilometers (26¼ miles), maximum gradient 3·5 per 100, or 1 in 28½, minimum radius 160 meters or 525 ft.

2. *Appenzellerbahn* (Winkeln-Herisau-Urnasch).—This is a meter gauge railway 14·7 kilometers (8·9 miles) long, with a maximum gradient of 3·8 per 100, or 1 in 26·3, and a minimum radius of 84 meters, or 275 ft. It was opened in April, 1875.

3. *Wadenswil-Einsiedeln Railway.*—This important little line was opened in May, 1877, arranged to be driven by screw wheel gear, but is now worked simply in the ordinary fashion. It is of normal gauge, 16·6 kilometers (10·4 miles) long. Its maximum gradient is 5 ft. per 100, or 1 in 20, and its minimum curve radius 150 meters (492 ft.).

4. *Arth-Rigi Railway.*—This line, on the north side of the mountain, with a station now (Arth-Goldau) on the main St. Gothard line, is the last constructed of the three Rigi railways, having been opened in June, 1875. It is of a normal gauge, and worked, like the original line, by spur-wheels gearing in a central rack. Its length is 11·6 kilometers (7¼ miles), maximum gradient 20 per 100, or 1 in 5, and minimum radius 100 meters, or 328 ft.

5. *Kaltbad-Scheidegg Railway.*—This little line, 6·7 kilometers (about 4¼ miles) long, runs along the shoulder of the Rigi from the Kaltbad Station on the Vitznau line to the Scheidegg. It is worked in the ordinary way without tooth gearing of any kind, its maximum gradient being only 5 per 100, or 1 in 20. It is of meter gauge, and its sharpest curves are 100 meters radius. It was opened in July, 1874.

6. *Uetliberg Railway.*—This again is a tourist's railway, from Zurich up to near the summit of the Uetliberg, a point of the Albis range commanding a very fine view. It is of normal gauge, and is the steepest railway in Switzerland (and we suppose anywhere else also), worked without special appliances. Its maximum gradient is 7 per 100, or 1 in 14¼, its minimum radius being 135 meters (443 ft.). Its length is 9·1 kilometers (5·7 miles). It was opened in May, 1875.

7. *Vitznau-Rigi Railway.*—This railway, from Vitznau on the Lake of Lucerne to the top of the Rigi, was opened in May, 1871, and was therefore the first of the rack railways. It has now been worked 12 years without, we believe, having had an accident. It is of normal gauge, 6·9 kilometers (3·6 miles) long, and its maximum (and nearly uniform) gradient is 25 per 100 meters, or 1 in 4. Its minimum radius is 180 meters, or 324 ft.

8. *Waldenburg Railway.*—This is a line of 13·5 kilometers (8·4 miles) in length with a maximum gradient of 3 per 100 (1 in 33), and worked of course without special appliances. It is noticeable because it is only 75 centimeters in gauge, or nearly 30 in., its minimum curve radius being only 60 meters, or 197 ft. It was opened in November, 1880.

In the Railway Works Section a model of the Pont du Javroz (Canton Fribourg) is worth notice as a specimen of wonderfully light iron construction. It is shown by Messrs. Ott and Co., the contractors, who built it in 1880–81, its cost being 197,000 francs. The total length of the bridge is 110 meters (361 ft.), the span of the arch being 86 meters (282 ft.), its height 57 meters (187 ft.).

In the River Works Section of Group 20 are collections of drawings of river rectifications and so on, which would not be interesting in the description although they will repay examination. It is specially worth notice, however, what extensive works the cantons find it necessary and worth while to undertake for the sake of confining within reasonable limits some impetuous brook, whose size in ordinary weather is of the very smallest. The Wildbach Verbauungen, the improvements in the Grunnbach, etc., are illustrations of this, while the Rhone Correction, Aar Correction, etc., are examples of the larger works.

The Town Work Section is of less general interest to outsiders than the others, important as it is to the people immediately concerned. The most striking part of it is perhaps the collection of historical maps exhibited by one or two towns. Bern especially show maps dated 1583, 1638, 1819 to 1821, and 1883, a comparison of which is entertaining enough.—*Engineering.*

A full page engraving of the Exhibition Building and its peculiar surroundings will be found in SCIENTIFIC AMERICAN SUPPLEMENT, No. 395.

THE NEW CHEAP POSTAGE ERA.

IT was in the midst of the war of the rebellion (3d March, 1863) that the act of Congress was passed which established the uniform rate of three cents postage for a half-ounce letter everywhere throughout the United States Prior to that the limit, under the act of 1855, was three thousand miles; and for any half ounce letter to be carried farther the charge was ten cents. Four years before that (1851), though the rates and distance were the same, it was required that the letters should be prepaid; or, if the letter was not prepaid, the postage was five cents for the three-cent letter, and twenty cents for the ten-cent letter. Going behind this again to 1845, the rate was five cents for a single sheet letter carried three hundred miles or under, and ten cents when the distance was over three hundred miles. Even that antiquated and expensive system, as it seems to us now, was regarded at the time when it went into effect as very cheap postage and simplicity itself as compared with the complex combinations of rates, sheets and distances which it superseded.

It is curious and instructive to note the results that followed the liberalizations of the postal service noted above. Before the marked and great reduction in 1845 the revenues of the Post Office Department had not increased for nine years; in 1836–37 the whole income was $4,236,779, while at the beginning of 1845–46 it was $4,289,841. With the reform of 1845, however, a new era began. Although there was considerable falling off for the next two years, the third brought the revenue up to the former level again and somewhat above, for it was $4,371,077 for the year 1847–48. From that time on the advance was rapid until 1850–51, when, under the decreased rates and enlarged distances, the revenue rose to $6,727,867. In the next following year, 1851–52, the first reduction to three cents for a prepaid half-ounce letter for three thousand miles took effect—the first year's result being a slight increase of revenue, and the second year's a large diminution. The third year again brought the Department's income up again to what it was before this last reduction of postage, $6,955,586, in the year 1853–54; and from that time on the increase was steady and large until in the year 1862–63 it had grown to $11,163,799. It was in this year that the three cent rate was made uniform all over the United States, since which date the augmentation of the revenue of the Department has been rapid and great. It is but twenty years since, but the revenue has increased four-fold, for in the year ending June 30, 1883, it was but little short of $45,000,000. This is a greater sum than the whole regular revenue of the United States from all sources was in the year 1859.

The experience of the past can hardly fail to be the experience of the future in the postal revenue. Every liberalization of the system, every reduction of rate, every enlargement of the distance a letter could be carried for one rate, every addition of facilities, has increased the post office business and its income. The reduction from three cents to two cents—thirty-three per cent. off what was a very low rate for the enormous distances in the United States as compared with those of any other commercial country—must probably result in a shortage for a few years, and then the advance will again set in and grow at the great ratios set forth in the above illustrations.—*Philadelphia Ledger.*

SCIENCE IN ANTIQUITY.

PERPETUAL LAMPS.

THE ancients utilized, in their prestiges, combustible gases, which, in many places, were disengaged naturally from the earth.

The Arab Schiangia, in a passage quoted by Father Kircher, expresses himself in this wise:

"In Egypt there was a field whose ditches were full of pitch and liquid bitumen. Philosophers, who understood the force of nature, constructed canals which connected places like these with lamps hidden at the bottom of subterranean crypts. These lamps had wicks made of threads that could not burn. By this means, the lamp, once lighted, burned eternally, because of the continuous influx of bitumen and the incombustibility of the wick."

It is possible that it was to an artifice of this same nature that were due some of the numerous perpetual lamps that history has preserved a reminiscence of, such as that which Plutarch saw in the temple of Jupiter Ammon, in Egypt, and that in the temple of Venus, which Saint Augustine could only explain as due to the intervention of demons. But the majority of them owed their peculiarity only to the precautions taken by the priests to feed them without being seen. It was only necessary, in fact, that the wick, which was made of asbestos threads or gold wire, should be kept intact, and that the body of the lamp should communicate with a reservoir placed in a neighboring apartment in such a way that the level of the oil should remain constant. Heron and Philo have left us descriptions of a certain number of arrangements that permitted of accomplishing such an object.

The same authors likewise point out different processes for manufacturing portable lamps in which the oil rises automatically. The most ingenious one is that which is at the present day known under the name of "Heron's Fountain."*

The following is the Alexandrine engineer's text:

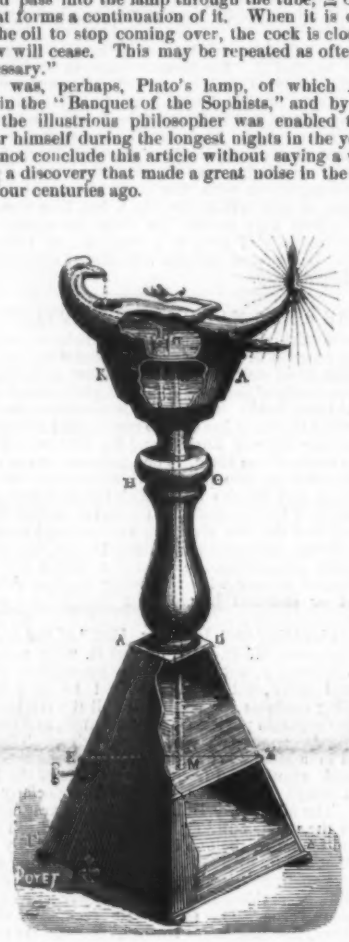
"Construction of a candelabrum such that upon placing a lamp thereon, there comes up through the handle, when the oil is consumed, any quantity that may be wished, and that, too, without there being any need of placing above it any vessel serving as a reservoir for the oil."

"A hollow candelabra must be made, with a base in the shape of a pyramid. Let $A B \Gamma \Delta$ be such pyramidal base, and in this let there be a partition, $E Z$. Again, let $H \Theta$ be the stem of the candelabrum, which should also be hollow. Above, let there be placed a vessel, $K \Lambda$, capable of containing a large quantity of oil. From the partition, $E Z$, there starts a tube, $M N$, which traverses it and reaches almost to the cover of the vessel, $K \Lambda$, upon which latter is placed the lamp in such a way as to allow only a passage for the air. Another tube, ΞO, passes through the cover and runs down on the one hand to the bottom of the vessel, $K \Lambda$, in such a way that the liquid may be capable of flowing, and on the other forms a slight projection on the cover. To this projection there is carefully adjusted another tube, Π, which is provided with a stopper at its upper part, and, traversing the bottom of the lamp and united with it, is wholly inclosed within the interior of the lamp. To the tube, Π, there is soldered another and very fine one which communicates with it and reaches the extremity of the lamp handle. This tube debouches in the latter in such a way that its contents may empty into the lamp, the orifice of which is of the usual size. Under the partition, $E Z$, there is soldered a cock that enters the compartment, $\Gamma \Delta E Z$, in such a way that when it is open the water from the chamber, $A B E Z$, may pass into the compartment, $\Gamma \Delta E Z$. Through the upper plate, $A B$, there is pierced a small hole, through which the compartment, $A B E Z$, may be filled with water, the air within escaping through the same aperture.

"Let us now remove the lamp and fill the vessel with oil by the aid of the tube, ΞO. The air will escape through the tube, $M N$, and afterward through a cock which is open near the bottom, $\Gamma \Delta$, when the water has flowed out from the compartment, $\Gamma \Delta E Z$. Let us place the lamp upon its base, connecting it at the same time with the tube, Π. When it becomes necessary to pour oil into it, we will open the cock near the partition, $E Z$. The water that is in the compartment, $\Gamma \Delta E Z$, as well as the air therein, being forced through the tube, $M N$, into the vessel, will cause the oil to rise and pass into the lamp through the tube, ΞO, and the one that forms a continuation of it. When it is desired to cause the oil to stop coming over, the cock is closed, when the flow will cease. This may be repeated as often as may be necessary."

Such was, perhaps, Plato's lamp, of which Athenæus speaks in the "Banquet of the Sophists," and by means of which the illustrious philosopher was enabled to have a light for himself during the longest nights in the year.

I cannot conclude this article without saying a word concerning a discovery that made a great noise in the scientific world four centuries ago.



PLATO'S LAMP.

"In our time," says Gesner (De lunariis herbis et rebus noctu licentibus), "there has been found near Padua an old monument in which there was an earthen urn with this inscription:

Plutoni sacrum manus ne attingite
fures;
Ignotum est vobis hoc quod in orbe
latet.
Namque elementa gravi clausit digesta
labore,
Vase sub hoc modico Maximus Olibius
Adsit fecundo custos sibi copia cornu,
Ne tanti pretium deperent laticis.

(Thieves! touch not this gift consecrated
to Pluto,
You know not what this urn contains.
The elements digested by hard work
Have been hidden in this little
vessel by Maximus Olibius.
May this fecund horn of plenty
be protected of itself,
So that so precious a liquid may
not perish.)

"In this urn there was a still smaller one, upon which these words were read:

Abite hinc pessimi fures;
Vos quid vultis vestris cum oculis
emissitiis?
Abite hinc vestro cum Mercurio
Petasato, caduceatoque
Maximus maximum donum Plutoni
hoc sacrum fecit.

(Get away from here, wicked thieves!
What desire you with your prying
eyes?
Get away from here with your
Mercury
Armed with his petasatus and his
caduceus.
Maximus has offered this great and
sacred gift to Pluto.)

"In this second urn there was found a lamp that was burning between two small viols, one of which was of gold and the other of silver, and both of which were filled with two kinds of pure liquids. . . ."

It seems that at the moment the peasants exposed the lamp to the light they saw a flame escape from it, and, seized with fear, they broke the whole with blows of their picks.

Under the pontificate of Paul III. there was likewise discovered in a tomb attributed to Tulliola, the daughter of Cicero, a lamp which went out as soon as the air had entered it.

In both cases it was fancied that the lamps had been burning for 1,500 years protected from the air, and that the latter had extinguished them. It is very probable that the contrary was the case, and that the two lamps contained phosphides of sulphur or some analogous material capable of igniting on contact with the air. What is certain is that antiquity possessed a certain number of chemical recipes that succeeding ages have allowed to become lost.—*A. De Rochas in La Nature.*

* In 1801, Carcel and Carreau applied Heron's system to lamps without, perhaps, knowing that they were thus returning to the primitive apparatus.

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